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NASAL MITES OF THAILAND BIRDS (Acarina: Rhinonyssidae)[1]

R. W. Strandtmann
Department of Biology
Texas Technological College, Lubbock, Texas

Introduction

In 1950, Mr. Robert E. Elbel informed me that he was being sent to Thailand by the United States Public Health Service to investigate, among other things, the incidence of sylvatic diseases in the wild animal population significant to the health of man. Knowing of my interest in bird nasal mites, he arranged to have samples of the birds taken in the course of his work sent to me at Lubbock. About this time also, Dr. Robert Traub became engaged on a similar mission to North Borneo and through his kind efforts, numbers of Borneo birds were put at my disposal. I sincerely thank both these gentlemen for supplying me with the host material and making this report possible. Mr. Elbel deserves especial credit for critically reading the manuscript. He checked the proper spelling of localities, added several host records, and offered helpful suggestions. I also wish to thank Mr. H. G. Deignan of the U. S. National Museum for identifying the birds he collected in Thailand in 1952 and 1953.

Collections were made possible by cooperative action of the U. S. National Museum, U. S. Operations Mission to Thailand, U. S. Army Medical Center, and the British Institute for Medical Research. It should also be mentioned that the cooperation of Dr. Chaisiri Kettanurak and the plague teams of the Thai Ministry of Public Health greatly facilitated the field work in Thailand.

I wish also to express my most sincere appreciation to Robert W. Mitchell, of Lamar College of Technology, Beaumont, Texas for executing the fine and very carefully done figures, 1-5, 9-10, 14-19, 21-25, 27, 40-41; and to Dr. Joe Hwang, Bureau of Animal Industry, Beltsville, Maryland, for figures 42, 43, 44, and 46.

Approximately 130 bird heads, representing ten orders and 58 species were examined. Mites were found in 26 heads. This represents a parasitemia rate of 20% which is about average for rhinonyssid nasal mites. Six genera and 16 species of mites were recovered, including five new species.

In addition to rhinonyssid mites, several species of the trombidiform Speleognathidae and the sarcoptiform Epidermoptidae were recovered. These will be reported in a subsequent paper.

Genus *Vitznyssus* Castro, 1948

Large, elongated mites, with well-formed tritosternum and a distinct, tined, palp-tarsal seta. As presently defined, the genus occurs in caprimulgi-

[1] Supported by Grant E 616 from the National Institutes of Health.

form birds and in primitive gruiform birds. It is very strange that two such widely divergent bird orders should have closely related mites; hence, it is quite likely that more material and further study will show characters that will clearly separate the mites of those two host orders.

Recently Fain (1959b), moved *Paraneonyssus capitatus* Strandtmann, 1956, to *Astridiella* (a synonym of *Vitznyssus*), solely on the basis of a very small tritosternum possessed by *capitatus*. This we deem insufficient reason.

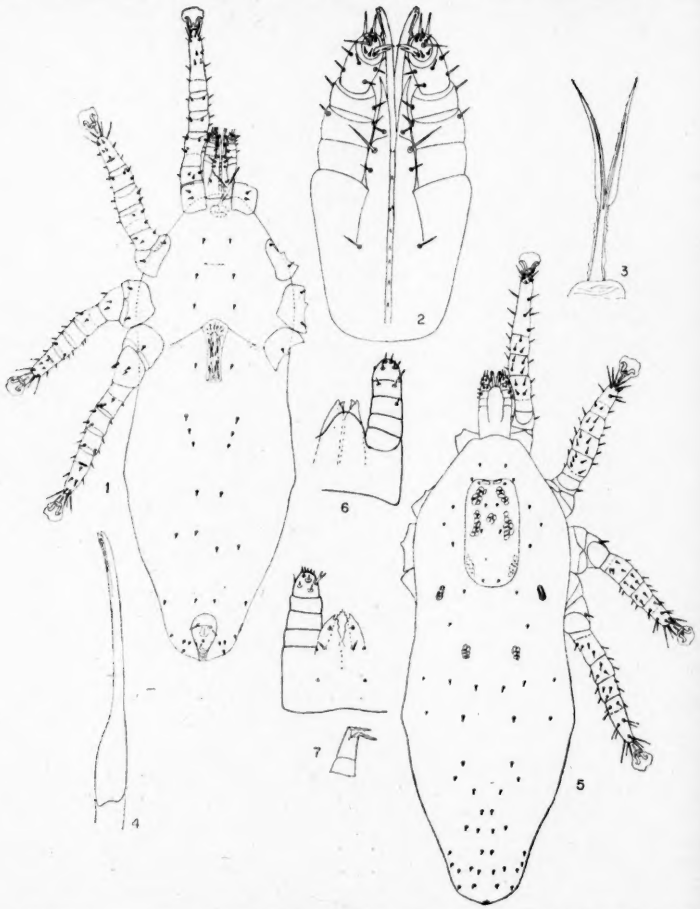

PLATE I. *Vitznyssus nitzschi*. Female: Fig. 1, ventral view; Fig. 2, ventral view of gnathosoma; Fig 3, tritosternum; Fig. 4, chelicera; Fig. 5, dorsal view. Larva: Fig. 6, dorsal view of gnathosoma; Fig. 7, tritosternum and ventral view of gnathosoma.

Vitznyssus has a subtle though distinctive facies; it merely happens that a well-developed tritosternum is a character that can be clearly and objectively stated but it should not be considered the sole criterion for generic differentiation. The presence or absence of *one* character is not sufficient in itself to determine generic placement. Actually, there are other species in which a trace of a tritosternum may be present, i.e., *Ptilonyssus oloai* Castro, and *Zumptnyssus* Fain (1959a).

The rather complex synonymy of *Vitznyssus* is discussed in Strandtmann and Wharton (1958:173). In that paper the authors unfortunately used the term "lectotype" when they really meant "neotype."

Vitznyssus nitzschi (Giebel)
(Figures 1-7)

Dermanyssus nitzschi Giebel, 1871:31
Neonyssus (*Vitznyssus*) *nitzschi,* Castro, 1948:277
Astridiella caprimulgi Fain, 1957b:96
Vitznyssus nitzschi, Strandtmann and Wharton, 1958:175

The specimens before us agree very closely with published descriptions of the species. The only difference noted is that the specimens are a bit larger and somewhat more tapered posteriorly.

Host and locality: Two females, one nymph moulting to male, and one larva; taken from the Long-tailed Nightjar, *Caprimulgus macrurus bimaculatus* Deignan, at Tha Uthen, Nakhon Phanom, Thailand, December 28, 1951, by Robert E. Elbel.

Remarks: As can be seen from figure 7, the larva also has the pronounced tined palpal seta and the distinct tritosternum characteristic of the genus.

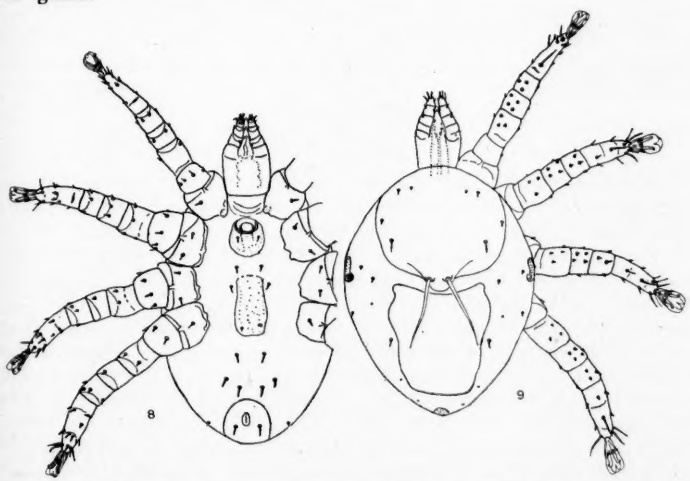

PLATE II. *Rhinoecius bisetosus.* Male: Fig. 8, ventral view; Fig. 9, dorsal view.

Genus *Rhinoecius* Cooreman, 1946

Mites of this genus have one or two dorsal plates and the stigma has a short peritreme. The most distinctive feature is the chelicera, which lacks the fixed arm. Strigiformes (owls), are apparently the only hosts. Six species are known, each from a different species of owl. Previous records are from Belgium, the United States, South Africa, and the Belgian Congo.

Rhinoecius bisetosus Strandtmann
(Figures 8-9)

Strandtmann, 1952:212

We have only three specimens, a male and two nymphs, so that really adequate comparison with the described form cannot be made. The only difference noted is that the pair of prominent setae on the dorsum is shorter than illustrated by Strandtmann (1952), and the other dorsal setae are a bit longer.

Host and locality: *Glaucidium cuculoides brugeli* (Parrot), the Barred Pygmy Owl, Ban Lat, Ban Kaeng, Phukhieo, Chaiyaphum, Thailand. January 15, 1952. Robert E. Elbel, collector.

Remarks: This owl is apparently closely related to the Burrowing Owl, *Speotyto cunicularia,* the type host. If so, it is not too surprising to find the same mite, in spite of the great geographic disparity.

Genus *Sternostoma* Berlese et Trouessart, 1889

The gnathosoma is ventrally directed and the pedipalps curve upward rather than downward. Legs I have thick coxae and poorly developed tarsal claws.

Other genera of Rhinonyssidae seem to be restricted to one order of hosts; *Sternostoma* occurs in many orders.

Furman (1957) has revised the genus. Fain (1957a) illustrates eleven African species. Between the two, most of the described forms are adequately illustrated. Four species, including one new, are recorded below.

Sternostoma furmani n. sp.
(Figures 10-15)

A medium small, elliptical mite. The dorsal posterior plate is nearly as large as the anterior plate, the sternal plate is eroded anteriorly, and about half the gnathosoma is visible from above.

Female. Length, 600 μ, varying from 500 to 680, width 330 μ (280-380). *Dorsum* (Fig. 11) with two large plates. The anterior plate is 245 μ long by 268 μ wide, the posterior plate is 200 μ long by 215 μ wide. The anterior plate bears eight pairs of tiny setae, the posterior bears three pairs. Both plates may have several small, round pores. There are no platelets and no setae on the unsclerotized portion of the dorsum. The stigma is dorsal and between coxae III and IV. Both dorsal plates may be less regular than is illustrated. *Venter* (Fig. 12). The sternal and genital plates are about of equal size, the sternal measuring 120 by 94 μ, the genital 140 by 100 μ. The sternal plate is lightly reticulated, bears three pairs of setae, and the anterior margin is strongly eroded. In most cases,

sternal setae I are on the plate but they may be off it. The genital plate is longitudinally reticulated and bears a pair of very small setae near its posterior margin. The anal plate is most often terminal but when in full view (Fig. 10), it is seen that the sides are thickened, the tiny paranal setae are below the posterior margin of the pore, and the area of the cribrum is lightly reticulated, rather than ciliated. There are from two to four pairs of small setae between the genital and anal plates.

Gnathosoma (Fig. 14). Typical for the genus, with short, up-curved palps, few setae, no deutosternal teeth, and no forked tarsal seta. Only two pairs of hypostomal setae are present and they are represented only by the

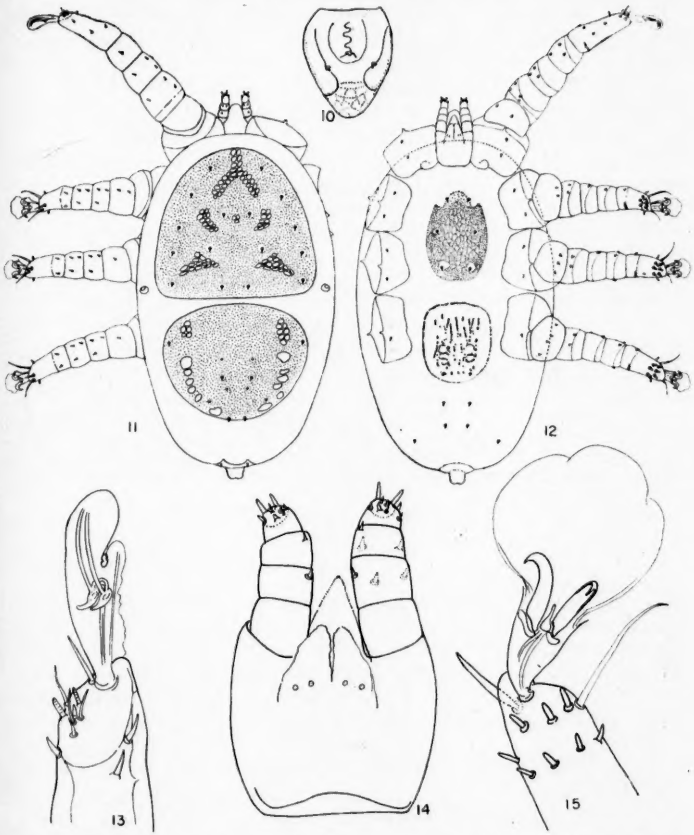

PLATE III. *Sternostoma furmani*. Female: Fig. 10, anal plate; Fig. 11, dorsal view; Fig. 12, ventral view; Fig. 13, tarsus I, showing sensitive area; Fig. 14, ventral view of gnathosoma; Fig. 15, ventral view of tarsus IV.

bases. The epipharynx is present, as illustrated. The tectum is a simple membrane extending to the base of the palp tibia. The gnathosomal details are extremely subtle.

Legs. Length in microns, including coxa but excluding ambulacrum: I, 350; II, 250; III, 270; IV, 285. All the setae, except on telotarsi, are small, slender, and pointed. On tarsus I they tend to be blunt toward the tip. The sensitive area (Fig. 13) shows two sensory setae which are about one-half as long as the longest hair-like seta. Telotarsi II, III, and IV are similar to each other. Each has three long, slender setae dorsally near the apex and six thick, obtusely pointed, ventral setae in two rows. There are two somewhat similar but more pointed setae laterally (Fig. 15).

Hosts and locality: *Arborophila brunneopectus erythrophys,* the Hill Partridge, collected at Trus Madi Mountain, Pampang, Ulu Kaingaran (4500 ft.), North Borneo, August 4 to 7, 1953, by Robert Traub and U. S. Army-British Colonial Office Medical Research Unit.

The description is based on ten female mites, all bearing the above data. The selected holotype is in the U. S. National Museum.

Remarks: The species may be instantly recognized by the relatively large posterior dorsal plate. The species is named in honor of Deane P. Furman, of the University of California, an outstanding acarologist.

This is the first species of rhinonyssid mite to be reported from a galliform bird.

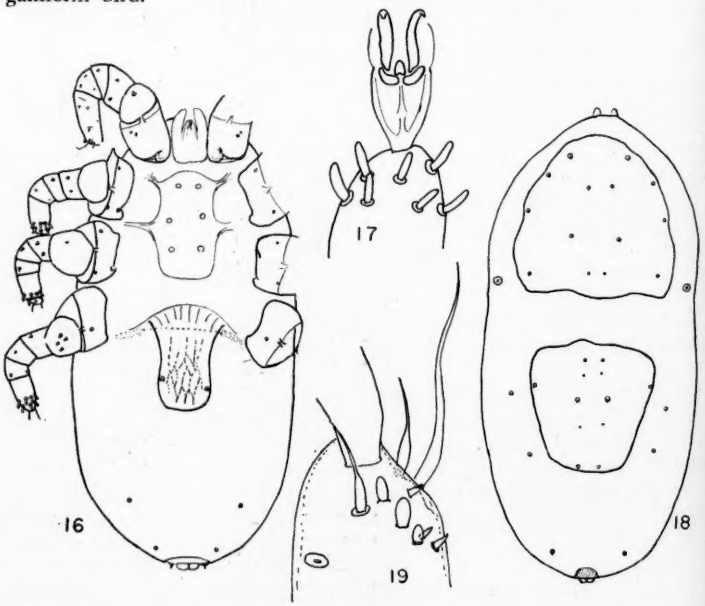

PLATE IV. *Sternostoma laniorum* var. *batis*. Female: Fig. 16, ventral view; Fig. 17, ventral view of tarsus II; Fig. 18, dorsal view. *Sternostoma nectarina*: Fig. 19, tarsus I of female.

Sternostoma laniorum var. *batis* Fain
(Figures 16-18)

Fain, 1957a:77

Two females were recovered from the Shama, one of the Turdidae. They agree closely with Fain's description and illustration of *laniorum* but have blunt tarsal setae and are therefore assigned to the variety *batis*. Fain illustrated only tarsus IV, stating that the shape of the tarsal setae was the only difference between *laniorum* and the variety *batis*.

Host and locality: *Copsychus malabaricus interpositus* (Robinson and Bodenkloss). Ban Nam Phu, Phukieo, Chaiyaphum, Thailand. December 22, 1952. Collected by Robert E. Elbel.

Remarks: The nominal species, *laniorum*, has been found only in the Laniidae. The variety *batis* was described from a Muscicapid. Finding it here in a Turdid suggests a close relationship of Turdidae and Muscicapidae. In this regard, it is interesting to note that Deignan, of the U. S. National Museum, now puts Turdidae under Muscicapidae as a subfamily, Turdinae.

Sternostoma nectarinia Fain
(Figure 19)

Fain, 1956; 1957a:58

The two specimens before us agree very closely with Fain's illustration. We note especially the heavy seta at the base of the sensitive area of tarsus I and the short, inflated setae in the same area.

Host and locality: Two female mites recovered from the Plain-colored Flowerpecker, *Dicaeum concolor olivaceum* Walden collected at Hin Laem, Tha Khanun, Kanchanaburi, Thailand, November 14, 1952, by Robert Elbel and H. G. Deignan.

Remarks: Fain (1957) reported this mite from four species of Nectariniidae. The mite is reported here from a species of Dicaeidae.

Sternostoma thieponti Fain
(Figures 20-22)

Fain, 1956: 1957a:68

The podosomal plate varies from nearly circular, as shown, to a rather pronounced triangular shape with undulate margins and biemarginate posterior margin. The opisthosomal plate is always broadened posteriorly. It may be considerably more narrowed anteriorly than is shown. The podosomal plate has eight pairs of setae but the number of setae on the opisthosomal plate varies from two to four. There are no other dorsal setae. The number of ventral setae varies from two to four. Fain shows only one pair of hypostomal setae: some of our specimens clearly have three pairs, as shown.

Hosts and locality: *Dicrurus macrocercus cathoecus* Swinhoe, the Chinese Black Drongo. Ban Lat, Ban Kaeng, Phukhieo, Chaiyaphum, Thailand. Collected by Robert E. Elbel, January 20, 1952. 32 females, five nymphs, no males.

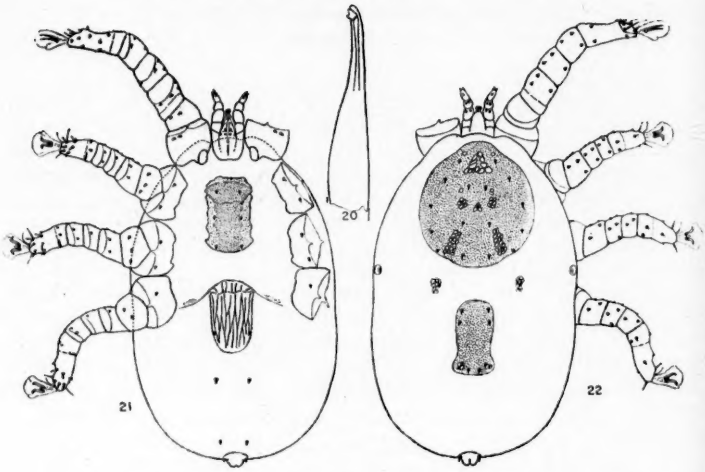

PLATE V. *Sternostoma thienponti*. Female: Fig. 20, chelicera; Fig. 21, ventral view; Fig. 22, dorsal view.

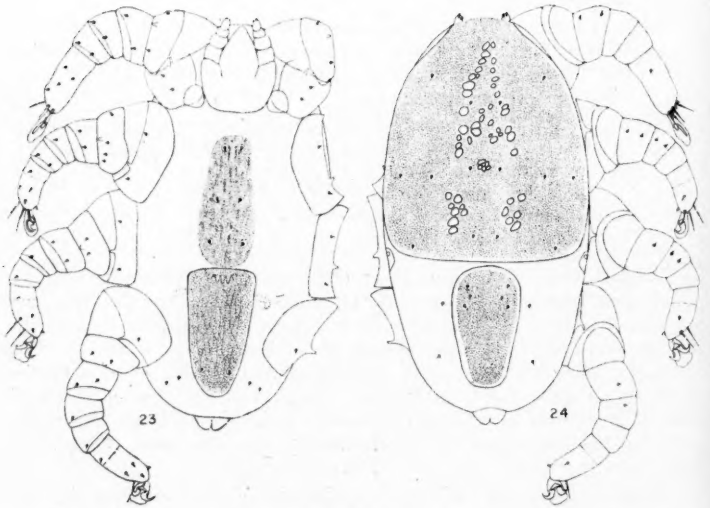

PLATE VI. *Sternostoma tracheacolum*. Female: Fig. 23, ventral view; Fig. 24, dorsal view.

Sternostoma tracheacolum Lawrence
(Figures 23-24)

Sternostoma tracheacolum Lawrence, 1948:364. Furman, 1957:478
Sternostoma castroae Fain 1956b:393

We have only two specimens of this mite. It differs somewhat from Lawrence's description, but not in characters that we consider of specific importance. Note the very large knobs on coxa I. These are internal structures.

Hosts and locality: *Nectarinia jugularis flammaxillaris* Blyth, the Purple-throated Sunbird. Khon San, Phukhieo, Chaiyaphum, Thailand, December 24, 1952. Robert E. Elbel, collector.

Remarks: The type host is the common, caged canary but it has been reported from several wild Passeriformes, including blackbirds and orioles (Icteridae), a swallow (Hirundinidae), a warbler (Sylviidae) and a wagtail (Motacillidae). Finding it in a sunbird (Nectariniidae) is, then, not unexpected.

Genus *Cas* Baker and Wharton, 1952

The legs are long and strong and the gnathosoma is anterior. Fain (1957a) considers *Cas* a synonym of *Sternostoma* but this is contrary to our belief. A new species is described below. It becomes the second species of the genus.

Cas elbeli n. sp.
(Figures 25-30)

A small to medium mite, from 520 to 730 μ long. The legs are long and heavy, the setae are small and sparse. The body is widest at legs II and III.

Female. Average length, excluding the gnathosoma, 586 μ; average width at widest point, 398 μ. *Dorsum* (Fig. 27) with two dorsal plates and two pairs of small platelets. The podosomal plate is large, and a bit wider than long. It measures 237 μ long by 250 μ wide. The margin is not always as smooth and entire as figured; it is often irregularly eroded. Four pairs of very small setae on the plate is average but the number may vary somewhat. The hysterosomal plate is generally pyriform, as figured, but may be nearly rectangular or rounded. It averages 135 μ long by 140 μ wide. It is not always as close to the podosomal plate as is shown. One pair of anterior setae is all we have found on the 13 females before us, but there is one pair of very small setae almost on the posterior margin.

The four small platelets vary greatly. They are often rounded. Twelve pairs of small, uniform setae on the unsclerotized portion of the dorsum is average. The number varies slightly and the number may not be the same on both sides.

The stigmal openings are dorsal, between legs III and IV.

Venter: (Fig. 28). There is no sternal plate and no indication of sternal pores. The three pairs of sternal setae are all equally medium heavy, medium small, and blunt. The genital plate lies entirely between coxae IV. The two genital setae are off the plate. The anal plate is seldom

as clearly defined as is illustrated. The paired anal setae are always on, or posterior to, a line through the posterior margin of the anal plate. There is never more than an indication of the third anal seta. A cribrum is never apparent. The ventral hysterosomal setae are medium small and

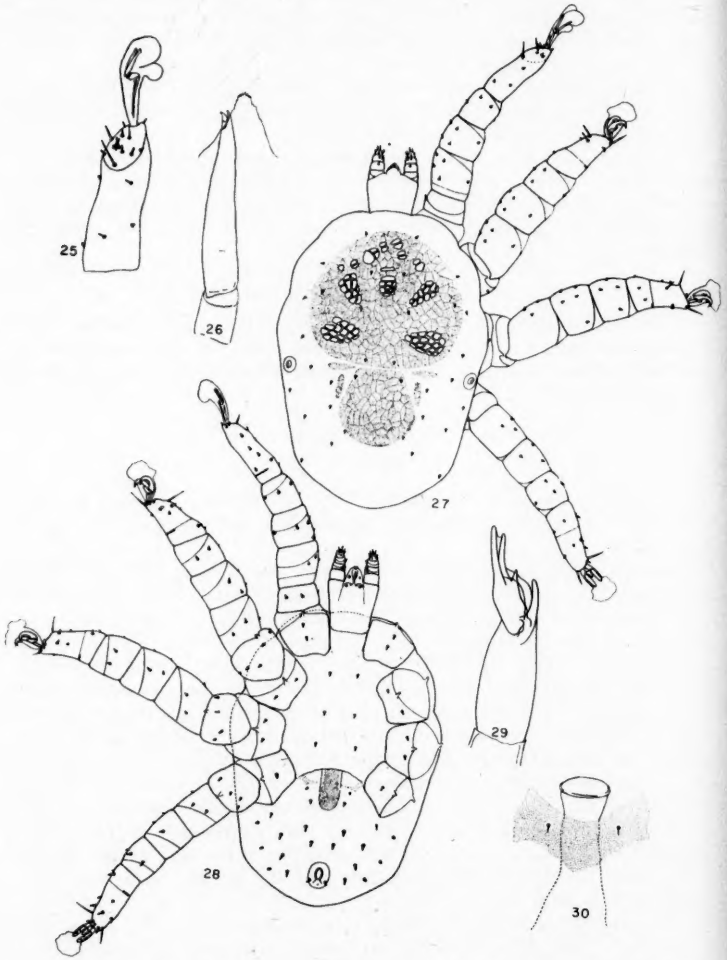

PLATE VII. *Cas elbeli*. Female: Fig. 25, tarsus I; Fig. 26, chelicera and tectum; Fig. 27, dorsal view; Fig. 28, ventral view. Male: Fig. 29, chelicera; Fig. 30, genital pore and plate.

heavy but considerably more pronounced than the dorsal setae. The mid-ventral setae, five to six pairs, are heavy and obtusely pointed. The two to three marginal pairs are smaller and rounded. One pair, near leg IV, is slender. There is no *tritosternum*.

The *legs* are heavy and long. It is remarkable that legs III are the longest, as this generally is the shortest pair. The legs, including the coxa but excluding the ambulacrum are, in microns: I, 455; II, 430; III, 470; IV, 450. All the ventral leg setae, from the coxa to the basitarsus, are short, broad, and obtusely pointed. The telotarsi of legs II and III have three to four short heavy setae that are directed vertically or even a bit posteriorly, not unlike a group of raised thumbs. Tarsi II-IV each have two slender, long setae apically. Dorsally, all leg setae are very small and slender.

The *gnathosoma* is terminal, being fully exposed in dorsal view. The movable segments of the palp are a bit shorter than the fused coxal bases. Deutosternal teeth are lacking as are also the gnathosomal setae. The hypostomal setae are cryptic but their bases can be made out with careful study. Chaetotaxy otherwise as illustrated. The tectum is an obtuse flap with a weakly serrate margin. There is an indication of a tined palpal seta but we never saw one clearly defined. The hypostomal details are extremely subtle.

Only one *male* was present in the collection before us. The chaetotaxy and the dorsum were not unlike the female. Ventrally, there was a lightly selerotized band below the genital pore. The first sternal setae were on this band (Fig. 30). The legs of the male measured: I, 360; II, 360; III, 390; IV, 370. The claws of leg I of the male are well formed, much like those of legs II-IV.

The collection contained three *nymphs*, all in a stage of moult. Nymphs lacked plates of any kind and had much smaller claws than the adults. Two of the nymphs were molting into females and one into a male. Legs of the two female nymphs measured respectively: I, 360 and 380; II, 380 and 380; III, 400 and 380; IV, 380 and 380. Legs of the male nymph measured: I, 280; II, 280; III, 300; IV, 280.

Hosts and locality: The holotype is a female taken from the nasal turbinates of *Sturnus nigricollis* (Paykull), the Black-collared Myna, at Ban Lat, Ban Kaeng, Phukhieo, Chaiyaphum, Thailand, January 16, 1952. Taken from the same host species were four additional females, one male and two nymphs. Other hosts and localities are: *Sturnus javanicus grandis* (Moore), the Crested Myna, Tha Uthen, Nakhon Phanom, Thailand, December 28, 1951; and *Sturnus tristis tristis* (Linnaeus), the House Myna, Pakraet, Banpong, Rat Buri, Thailand, April 15, 1952. All collected by Robert E. Elbel. The description is based on twelve females, one male and three nymphs. The holotype female is in the U.S. National Museum, Washington, D.C.

Remarks: The only other known species of *Cas* is *Cas angrensis* (Castro) found in swallows, (Hirundinidae). In *C. angrensis*, the body setae are very pronounced and very much inflated, the genital setae are on the genital plate, the anal plate has a cribrum, and the dorsal hysterosomal plate is transverse.

It is of more than passing interest to note that a species of *Cas* found by Dr. Gordon Clark at Patuxant, Maryland, in Starlings *(Sturnus vulgaris)* is almost indentical to *C. elbeli*. Starlings and Mynas are closely related birds, being congeneric.

The mite is named in honor of Robert E. Elbel who collected these mites, and most of the other mites reported in this paper, during his stay in Thailand.

Genus *Ptilonyssoides* Vitzthum, 1935

Fain (1957a) reduced to the synonymy of *Ptilonyssus* all those generic names proposed for mites with a peritreme and with minute chelae. This does seem to be the best solution for the group but we prefer to retain the old names as long as they can be associated with distinctive features.

In *Ptilonyssoides* there are three dorsal plates in the adults and in the nymphs *the pygidial setae are short,* as in the adults. In *Ptilonyssus sensu stricta* the pygidial setae of the nymphs are long and ciliated, and there are only two dorsal plates in the adult female.

Two old and one new species are recorded below. The new species brings the known forms, as here restricted, to five.

Ptilonyssoides dicruri (Fain)

(Figures 31-33)

Ptilonyssus dicruri Fain, 1956; 1957a:122
Ptilonyssoides dicruri, Strandtmann and Wharton, 1958:170

Female about 700 μ long; male about 500 μ. The material we have

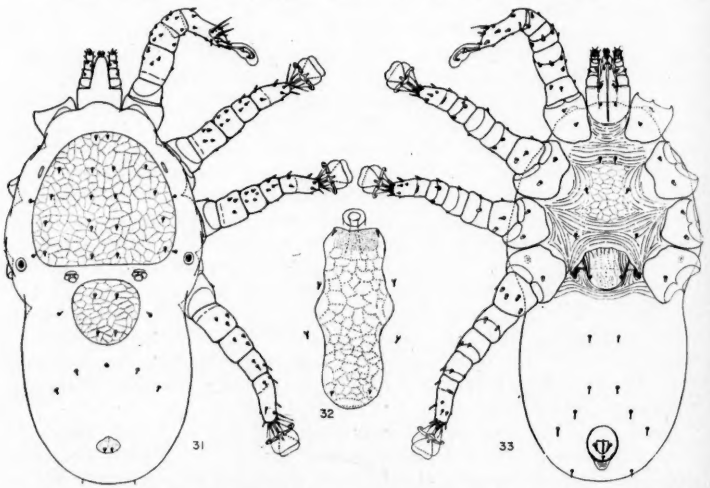

PLATE VIII. *Ptilonyssoides dicruri.* Fig. 31, dorsal view of female; Fig. 32, male genital plate and pore; Fig. 33, ventral view of female.

from Borneo birds agrees very closely with Professor Fain's excellent illustration of the species, with major exceptions as follows: the sternal plate has no definite margin, Fain shows it with a margin; our specimens have three pairs of hyposternal teeth, Fain shows only two pairs; we failed to find deuterosternal teeth, Fain shows them as clearly present.

It should be noted that the dorsal plates are not always as regular as here illustrated, but even so, the posterior margin of the anterior plate is always truncate. The pygidial plate is occasionally divided and one or both setae may be off the plate. The male sternigenital plate reaches to the middle of coxae IV and only the first pair of setae are on it. A broad, sclerotized band is present at the anterior margin of the plate.

The protonymph shows six deutosternal teeth, a podosomal plate, and a pygidial plate. The middle dorsal plate is absent. The pygidial setae are small, as in the adult. The apical one-third of the chelicera is attenuated.

Hosts and locality: One male and nine females from *Dicrurus macrocercus cathoecus* Swinhoe, the Chinese Black Drongo. Ban Lat, Ban Kaeng, Phukhieo, Chaiyaphum, Thailand, January 20, 1952, Robert E. Elbel collector. Also 11 males, 16 females, six protonymphs, and three larvae taken from *Dicrurus leucophaeus stigmatops,* the Ashy Drongo, at Kinabalu Mountain, Tenompak (5500 ft.), North Borneo, by Robert Traub, U. S. Army Medical Research Unit, July 20, 1951.

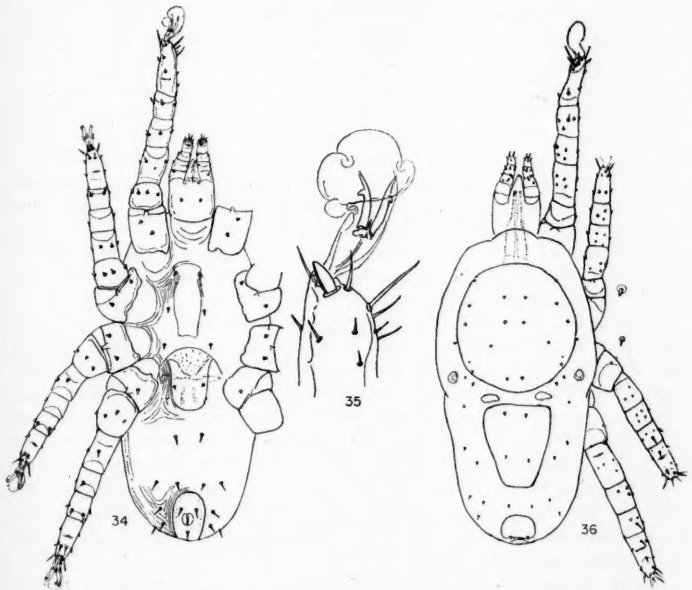

PLATE IX. *Ptilonyssoides dioptrornis.* Female: Fig. 34, ventral view; Fig. 35, tarsus I; Fig. 36, dorsal view.

Ptilonyssoides dioptrornis (Fain)

(Figures 34-36)

Ptilonyssus dioptrornis Fain, 1956:137; 1957a:124

Ptilonyssoides dioptrornis, Strandtmann and Wharton, 1958:170

We have one female. It agrees closely with Fain's description and illustration except that the sternal plate is a bit larger and the ventral setae a trifle longer. The specimen has a prominent, apical spur on the inner side of tarsus I which Fain does not show in his 1957 paper but in a later publication (Fain, 1959b) he states that it is present.

Host and locality: A small unidentified thrush-like bird (No. R E 634), collected at Banpong, Rat Buri, Thailand, April 10, 1952, by Robert E. Elbel.

Remarks: Fain reported this mite from one species of Muscicapidae and three species of Turdidae. Our record from a thrush is therefore to be expected.

Ptilonyssoides faini n. sp.

(Figures 37-41)

A large, elongated mite with, blunt, inflated setae on the ventral leg segments.

Female. The female averages 955 μ long but varies from 600 to 1040 μ. The average width is 500 μ. *Dorsum* (Fig. 41). The three plates typical of the genus are all present but somewhat reduced. The podosomal plate is concave laterally and biemarginate on the posterior border. It measures 275 μ long and 225 μ wide. Six pairs of small setae are arranged on the plate as figured. The median plate is quadrate to round and may be wider than long. The measurements of ten specimens average 95μ long and 90 μ wide. It has one pair of small setae. Two small, roundish platelets are found laterally between the podosomal and the median plate. The pygidial plate is typical; with one pair of small setae. It measures 40 μ long by 50 μ wide. The stigma, with its circular peritreme, is dorsal, between coxae III and IV. Off the plate, in the podosomal area, are three pairs of small setae. In the opisthosomal region, five pairs of small setae is average.

Venter. (Fig. 37). The sternal shield is not a distinct, sclerotized plate; its presence is indicated only by a lack of striations. The three pairs of blunt sternal setae are not on the unstriated area. The *genital shield* is narrowed and has a rounded posterior margin. It is 100 μ long by 70 μ wide. The genital setae were never on the plate in the 11 females before me. The *anal* shield is fairly large and distinct. It averages 130 μ long by 95 μ wide. The cribrum is distinct. There is a dark band between the anal pore and the cribrum which extends about midway up the sides of the plate. The anterior margin is weak. The paired paranal setae are placed near the anterior margin of the pore. The odd paranal seta is either lacking or present only as a small pore.

About six pairs of fairly long and slender, but obtusely pointed, setae are on the venter posterior to the genital setae.

Legs. In all our specimens the legs were flexed and measurements

therefore were not made. All the coxal setae were blunt and inflated. On coxa I the anterior seta was always larger than the posterior one, as illustrated (Fig. 37). The chaetotaxy otherwise is as illustrated. It will be noted that the trochantal setae are largest and that the setae become progressively smaller, distally. The tips of the tarsi ventrally have two to four pronounced setae but they are not unusually strong. Dorsal leg chaetotaxy as shown (Fig. 41). The setae are quite small and inconspicuous.

Gnathosoma. (Fig. 40). The movable segments about as long as the fused coxae. The gnathosomal setae present and somewhat inflated. The hyposternal setae are all there but are small and inconspicuous. Note that

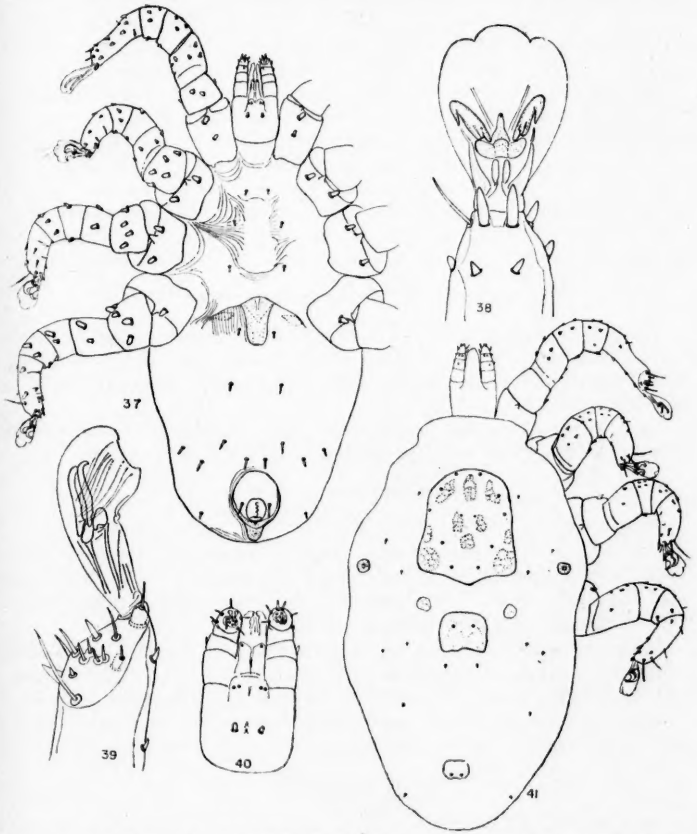

PLATE X. *Ptilonyssoides jaini.* Female: Fig. 37, ventral view; Fig. 38, ventral view of tarsus II; Fig. 39, dorsal view of tarsus I; Fig. 40, ventral view of gnathosoma; Fig. 41, dorsal view of female.

the apical pair of hypostomal setae is in an exaggerated forward position. The tectum is a slender, rounded membrane reaching nearly to the tip of the palps.

The *nymph* measured 800 μ long. It was not cleared sufficiently to see the plates but the characteristic inflated setae were clearly visible.

The *larva* was 480 by 400 μ. It had no plates and no stigma. The setae were very small but they were inflated.

Host and locality: *Dicrurus hottentotus borneensis,* the Hair-crested Drongo, captured at Trus Madi Mountain, Pampang, Ulu Kaingaran (4500 ft.), North Borneo, July 30, 1953 by Robert Traub and U. S. Army-British Colonial Office Medical Research Unit.

Types: The description was based on 11 females and one nymph. One of the females was designated the holotype and it, along with two paratype females, are in the U. S. National Museum, Washington, D. C.

Remarks: This mite is in many respects similar to *P. dicruri* Fain but it differs constantly in a number of respects and we feel no hesitancy in pronouncing it a new species. It differs from *dicruri* in: the median dorsal plate is smaller, having only one pair of setae; the podosomal plate is smaller and has a biemarginate posterior border; the genital setae are not on the plate; coxal setae I, especially the anterior, are strongly inflated.

The species is named in honor of Dr. Alex Fain, of Anvers, Belgium, who has contributed so much to our knowledge of African mites.

Genus *Ptilonyssus* Berlese et Trouessart, 1889

The genus is here restricted to mites with distinctly attenuated chelicerae, minute chelae, and two dorsal plates in the female; one podosomal and one small pygidial. They are medium small and elongated mites restricted to passeriform birds.

Even as here restricted, it is a large genus, containing over 25 species. Included in this paper are four species, of which two are new.

Ptilonyssus andropadi Fain

Fain, 1956:141; 1957a:114

We have one female specimen. The venter of this specimen agrees exactly with Fain's figures but the dorsal side seems to have more heavy setae than Fain shows. The specimen was unfortunately crushed before we had an opportunity to sketch it.

Host and locality: *Hypsipetes flavala connectens,* Brown-eared Bulbul, collected at Kinabalu Mountain, Tenampok (5500 ft.), North Borneo. July 20, 1951, by Robert Traub, U. S. Army Medical Research Unit.

Remarks: The type host, *Andropadus latirostris* from Central Africa, and the host recorded above, are members of the family Pycnonotidae.

Ptilonyssus traubi n. sp.
(Figures 42-48)

A medium-large mite, with a nearly square pygidial plate, four small dorsal platelets, heavy, clawlike tarsal setae and unusually long dorsal palp setae.

Female. 950 μ long, 420 μ wide. *Dorsum*. (Fig. 42). The podosomal plate is reverse pyriform and measures 290 μ long by 220 μ wide at the widest point. It bears 10-14 very small, blunt setae and on each side, opposite the narrowest portion, is a small platelet. It should be noted that a pair of platelets in this region is unusual for the genus. Below the podosomal plate and fairly widely separated, are the two platelets that are normal for the genus. The stigma and short peritreme are dorsal, above leg III. The pygidial plate is longer than wide, which is rather uncommon

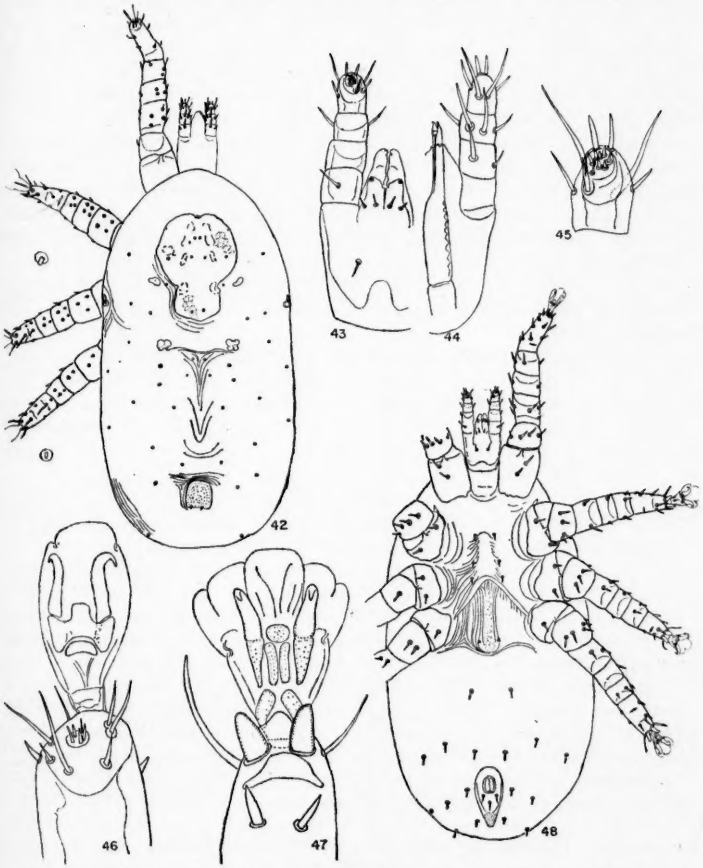

PLATE XI. *Ptilonyssus traubi*. Female: Fig. 42, dorsal view; Fig. 43, ventral view of gnathosoma; Fig. 44, chelicera and dorsal view of tritosternum; Fig. 45, ventral view of palp tibia and tarsus; Fig. 46, tarsus I; Fig. 47, ventral view of tarsus II; Fig. 48, ventral view of female.

for *Ptilonyssus*. It measures 85 μ long by 60 μ wide. It has the two characteristic setae on the posterior margin. Scattered over the rest of the dorsum are 14-15 pairs of very small, blunt setae.

Venter. (Fig. 48). All the ventral setae are slender, pointed, and reasonably long. There are three pairs of sternal setae, of equal length. Sternal pores are lacking. The sternal plate lacks distinct borders. The genital plate is long, slender, broadened and rounded posteriorly, has a pair of small pointed setae on the margins at the widest point, and measures 210 μ long by 44.5 μ wide at the widest. The anal plate is narrowly obovate with the pore in the anterior half, the three anal setae of equal length all placed below the pore, the margins of the plate slightly thickened posteriorly from a point opposite the middle of the pore, and the cribrum well developed. There are eight pairs of ventral, opisthosomal setae, all about equally long. There is no trace of a tritosternum.

Gnathosoma (Figs. 43, 44). The anterior pair of hyposternal setae is small and obtuse; the posterior, paired hypostomal setae are slender and long. The pair of gnathosomal setae are also slender and a bit longer than the hyposternal. The palp tarsus is a small pad at the ventral apex of the palp tibia. It bears eight small setae and a rather indistinct, tined seta. Dorsally, the three apical segments of the palp bear long, slender setae, as illustrated. Only the apical half, or less, of the chelicera is attenuated, differing in this respect from most *Ptilonyssus*. Deutosternal teeth are apparently lacking.

Legs. Dorsally, the setae are small and pointed, except on the tarsi, where there are four to five long, slender setae. Ventrally the setae are long, pointed, and very slightly thickened. All are of about equal length, including the coxal setae. The apices of tarsi II-IV have each a pair of heavy claw-like setae ventrally (Fig. 47). The anterior margin of coxa II has a tooth-like spine.

Hosts and locality: An unidentified bird collected at Kinabalu Mountain, Tenompak (5000 ft.-5500 ft.), North Borneo, July 15-20, 1951. Collected by Robert Traub, U. S. Army Medical Research Unit.

Types: Described from three female mites. The holotype is deposited in the U. S. National Museum, Washington, D. C. The two paratypes are in the acarology collection at Texas Technological College, Lubbock, Texas.

Remarks: The shape of the chelicera readily separates this species from most other *Ptilonyssus*. By the shape of the chelicera, the dorsal plate, and the very heavy tarsal claw-like setae, *P. traubi* closely resembles *P. olaoi* Pereira and Castro (1949:219). It differs from *olaoi* as follows: very long setae on dorsal palp segments, more ovate anal plate, presence of two platelets opposite the podosomal plate and lack of a vestigial tritosternum.

This mite is named in honor of Dr. Robert Traub, who collected this and many other mites in North Borneo.

Ptilonyssus echinatus Berlese et Trouessart
(Figures 49-51)

Berlese et Trouessart, 1889:126; Zumpt and Till, 1955:74.

As is generally true for nasal mites of the Hirundinidae, the ventral setae are prominent. The genital plate is narrow and pointed; the anal

plate is distinct, long, and narrowly ovoid, the three paranal setae are all prominent and equal and well posterior to the pore. The stigma and short peritreme, between coxae II and III, generally are lateral but may be dorsal or ventral. In our material, (six females only), all specimens had the pygidial plate divided, as shown. The dorsal setae are hardly as prominent on the specimens as shown on the drawing.

Host and locality. Six female mites taken from the nasal chambers of the House Swallow, *Hirundo rustica gutturalis* Scopoli, at Phayuhakiri,

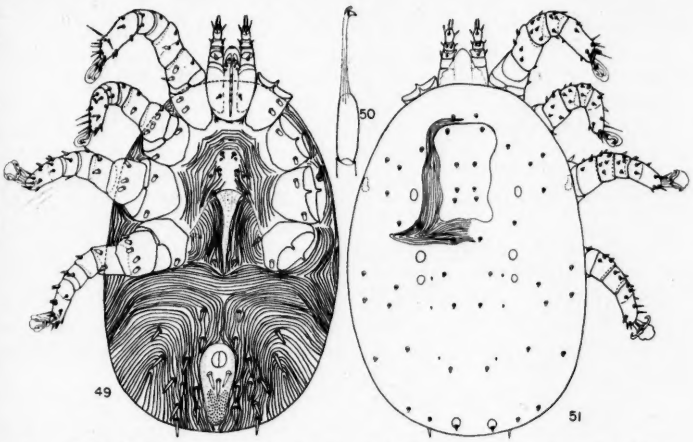

PLATE XII. *Ptilonyssus echinatus*. Female: Fig. 49, ventral view; Fig. 50, chelicera; Fig. 51, dorsal view.

Nakhon Sawan, Thailand; March 8, 1953 by Robert E. Elbel.

Remarks: One of the females contained a larva. In it, the chelicerae are not attenuated.

Ptilonyssus lobatus n. sp.

(Figures 52-56)

A thick-bodied mite having two large lateral humps on the upper surface of the opisthosoma.

Female. Average length, 1140 μ (940-1250); width 540 μ (520-610). *Dorsum* (Fig. 52). Podosomal plate, 283 μ long by 310 μ wide. In general, the plate is as illustrated, strongly convex laterally and a bit emarginate on the anterior border. The posterior-lateral angles are pronounced when a pair of small platelets are attached as illustrated, but the plate may be rounded posteriorly by the detachment of these platelets. The stigma and short peritreme are dorsal to leg III. The pygidial plate measures 40 μ long by 100 μ wide and has the typical pair of small setae on the posterior margin. The plate may be divided. The *dorsal chaetotaxy* is accurately shown as to size and shape of setae. The actual number and placement of

the setae is somewhat variable, but the illustration shows a typical arrangement.

Venter (Fig. 56). The *sternal plate* extends to the genital. Actually it is more a non-striated area than it is a plate. Sternal setae I are in the non-striated area, setae II and III are generally out of it. The *genital plate* averages 215 μ long and 75 μ wide. The width varies considerably, however, from 50 to 100 μ. Generally, the genital plate is as shown, wide posteriorly and the setae well within the margin, but occasionally the plate is narrowed sufficiently that both setae are off the plate. The anal plate is markedly extended posteriorly, as shown; all three setae are well below

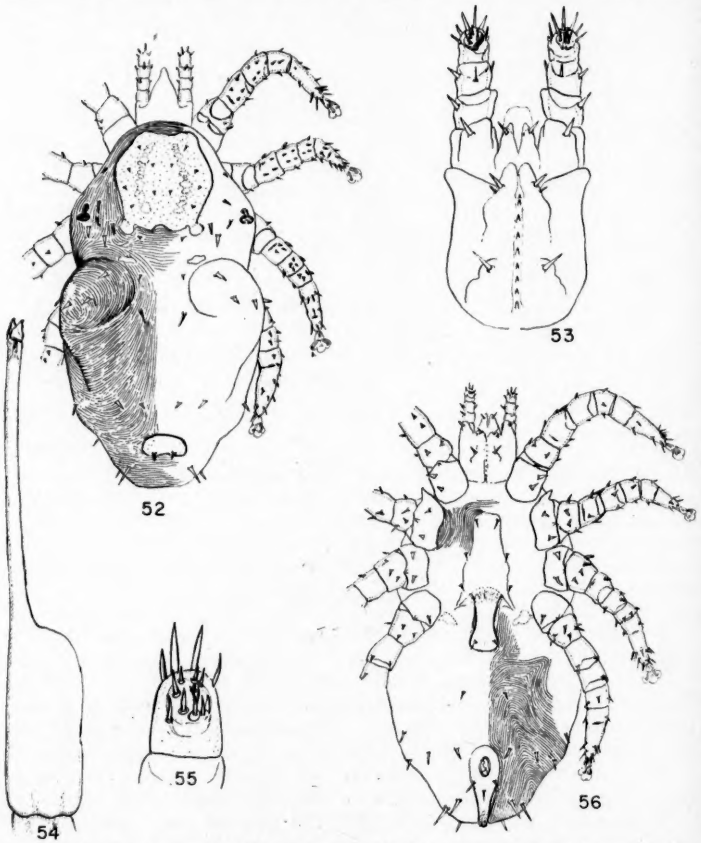

PLATE XIII. *Ptilonyssus lobatus*. Female: Fig. 52, dorsal view; Fig. 53, ventral view of gnathosoma; Fig. 54, chelicera; Fig. 55, ventral view of palp tibia and tarsus; Fig. 56, ventral view of female.

the anal pore; the cribrum is well developed. The ventral chaetotaxy is accurately figured. The number and position of the setae does not vary much in the 23 females before us.

Legs. Average length, including coxa but excluding ambulacrum: I, 650; II, 475; III, 470; IV, 850. The chaetotaxy as shown. There are no markedly long nor heavy setae. The anterior projection on coxa II is a pointed, fleshy lobe, rather than a spine.

Gnathosoma (Figs. 53, 55). Chaetotaxy as shown. The tined seta is rather small and slender but distinctly present. There are seven to nine obvious deutosternal teeth. The tectum is a simple membrane flap. The *chelicera* (Fig. 54) is sharply attenuated, typical for the genus.

Host and locality: The holotype female was taken from *Sturnus javanicus grandis* Moore, the Crested Myna. Khao Yoi, Phet Buri, Thailand. April 20, 1952. Robert E. Elbel, collector. Specimens were also taken from *Sturnus tristis tristis* (Linnaeus), the House Myna, at Banpong, Rat Buri, Thailand, April 16 and 17, 1952, collected by Robert E. Elbel, and at Hin Laem, Tha Khanun, Kanchanaburi, Thailand by Robert E. Elbel and H. G. Deignan on October 27, 1952.

Type material: 23 females and three nymphs, all bearing the above data. The holotype female and several paratypes are in the acarology collection at the U. S. National Museum, Washington, D. C.

Remarks: The species differs from others in the genus chiefly by the remarkable swellings on the dorsal side of the opisthosoma. But the shape

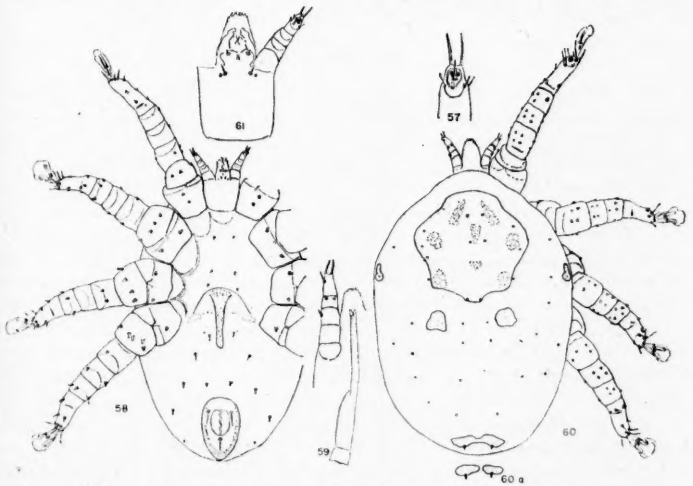

PLATE XIV. *Ptilonyssus orioli*. Female: Fig. 57, ventral view of palp tibia and tarsus; Fig. 58, ventral view of female; Fig. 59, chelicera and dorsal view of gnathosoma; Fig. 60, dorsal view of female; Fig. 60a, divided pygidial plate; Fig. 61, ventral view of gnathosoma.

and size of the setae and shape of the anal plates, coupled with the posteriorly broadened genital plate also serve to distinguish the species.

Ptilonyssus orioli Fain

(Figures 57-61)

Fain, 1956:144; 1957a:114

The two female specimens before us agree exactly with Dr. Fain's description and illustration of the ventral view, but dorsally our specimens have small, inconspicuous setae and a narrow, wide pygidial plate whereas Fain shows prominent setae and a nearly circular pygidial plate. It should also be noted that tarsi II-IV each have a short, broad dorsal seta. Tibia I has a pair of adjacent setae dorsally but since only one of our specimens had legs I present, we cannot say if this is merely an abnormality. Fain did not illustrate or describe the dorsal leg chaetotaxy.

Host and locality: *Oriolus xanthornus xanthornus* (Linnaeus), the Black-headed Oriole. Hin Laem, Tha Khanun, Kanchanaburi, Thailand, November 1, 1952, Robert E. Elbel and H. G. Diegnan.

Remarks: This species is known only from the *Oriolidae*. Fain (1957a) remarked that *P. orioli* is similar to *Rhinonyssoides trouessarti* Hirst, 1921:770, which indeed it is. Since *trouessarti* is from an Oriolidae the likelihood is great that it is a *Ptilonyssus sensu strictu*. This would make *Rhinonyssoides* Hirst an absolute synonym of *Ptilonyssus* (as *Trouessarti* is the generotype), and Fain (1957) therefore was completely justified in so considering it. It is unfortunate that Hirst did not describe or illustrate the dorsal side of *trouessarti*.

SUMMARY

Fifty-eight species of birds from Thailand and Borneo were examined for nasal mites (Rhinonyssidae). Following is a list of the mites recovered, and their hosts. (1) *Vitznyssus nitzschi* (Giebel) from *Caprimulgus macrurus bimaculatus;* (2) *Rhinoecius bisetosus* Strandtmann from *Glaucidium cuculoides brugeli;* (3) *Sternostoma furmani* n. sp. from *Arborophila brunneopectus erythrophys;* (4) *Sternostoma laniorum* var. *batis* Fain from *Copsychus malabaricus interpositus;* (5) *Sternostoma nectarinia* Fain from *Dicaeum concolor olivaceum;* (6) *Sternostoma thienponti* Fain from *Dicrurus macrocercus cathoecus;* (7) *Sternostoma tracheacolum* Lawrence from *Nectarina jugularis flammaxillaris;* (8) *Cas elbeli* n. sp. from *Sturnus nigricollis, Sturnus javanicus grandis* and *Sturnus tristis tristis;* (9) *Ptilonyssoides dicruri* (Fain) from *Dicrurus macrocercus cathoecus* and *Dicrurus leucophaeus stigmatops;* (10) *Ptilonyssoides dioptrornis* (Fain) from an unidentified thrush; (11) *Ptilonyssoides faini* n. sp. from *Dicrurus hottentotus borneensis;* (12) *Ptilonyssus andropadi* Fain from *Hypsipetes flavala connectens;* (13) *Ptilonyssus traubi* n sp. from an unidentified bird taken in North Borneo; (14) *Ptilonyssus echinatus* Berlese and Trouessart from *Hirundo rustica gutturalis;* (15) *Ptilonyssus lobatus* n. sp. from *Sturnus javanicus grandis* and *Sturnus tristis tristis;* (16) *Ptilonyssus orioli* Fain from *Oriolus xanthornus xanthornus.*

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AN UNDESCRIBED TINGID FROM ARIZONA (Hemiptera)

CARL J. DRAKE AND FLORENCE A. RUHOFF
Smithsonian Institution, Washington, D.C.

Most of the present knowledge of the Hemiptera of the Huachuca Mountains, Arizona, is based upon specimens netted in these mountains by the late Harry G. Barber, more than 50 years ago. Among this material, we have found a long series of an undescribed species of a lace-bug in the genus *Leptoypha* Stål, which had been wrongly identified and confused in the literature with two other members of the genus. This new species is characterized herein and named in honor of our friend and co-worker, who was one of the most eminent and active leaders in the field of Hemiptera for more than a half century.

The male holotype (USNM type number 64937 is in the Barber Collection, paratypes in the American Museum of Natural History, the British Museum (Nat. Hist.), and in the collections of the authors. The illustration (fig. 1) was drawn by Caroline B. Lutz, Arlington, Va. This paper is a by-product of a grant in aid on tingid studies by the National Science Foundation (04095).

Leptoypha barberi, new species (Fig. 1)

Leptoypha brevicornis: Barber, 1910, New York Ent. Soc., vol. 18, p. 38.

Small, oblong, brownish testaceous, with head and pronotal disc reddish brown, and body beneath reddish brown to blackish; elytra with fuscous markings as in illustration (Fig. 1); dorsal surface sparsely, inconspicuously clothed with minute, golden, flake-like pubescence; legs brownish testaceous, all femora (apices pale) dusky fuscous. Length 2.60 mm., width 0.80-0.92 mm.

Head very short, feebly extended in front of eyes, strongly declivent, armed with four or five whitish testaceous spines; hind pair of spines long, appressed, the three frontal spines short, porrect, median spine often absent; eyes moderately large, reddish fuscous; bucculae wide, closed in front, triseriate. Labium brownish, with tip black, extending to base of mesosternum; laminae of rostral sulcus pale testaceous, uniseriate, parallel on mesosternum, more widely separated, cordate, and closed behind on metasternum. Antennae moderately stout, short, segmental measurements: I, 0.20 mm.; II, 0.12 mm.; III, 0.50 mm.; IV, 0.25 mm. Metathoracic scent glands with ostiole and short, upright sulcus on each metapleuron. Hypocostal lamina long, uniseriate.

Pronotum strongly convex, coarsely punctate, unicarinate; median carina quite distinct, without areolae, the lateral carinae absent; collar areolate, raised, truncate in front; calli impressed, impunctate; paranotum very narrow, cariniform, slightly wider opposite calli, without cells; posterior projection of pronotum triangular, areolate. Legs short, moderately stout, with femora very little swollen, sparsely clothed with tiny, flake-like, yellowish pubescence. Elytra not wider than pronotum at humeri, slightly constricted on lateral sides beyond middle, longer than abdomen; costal area narrow,

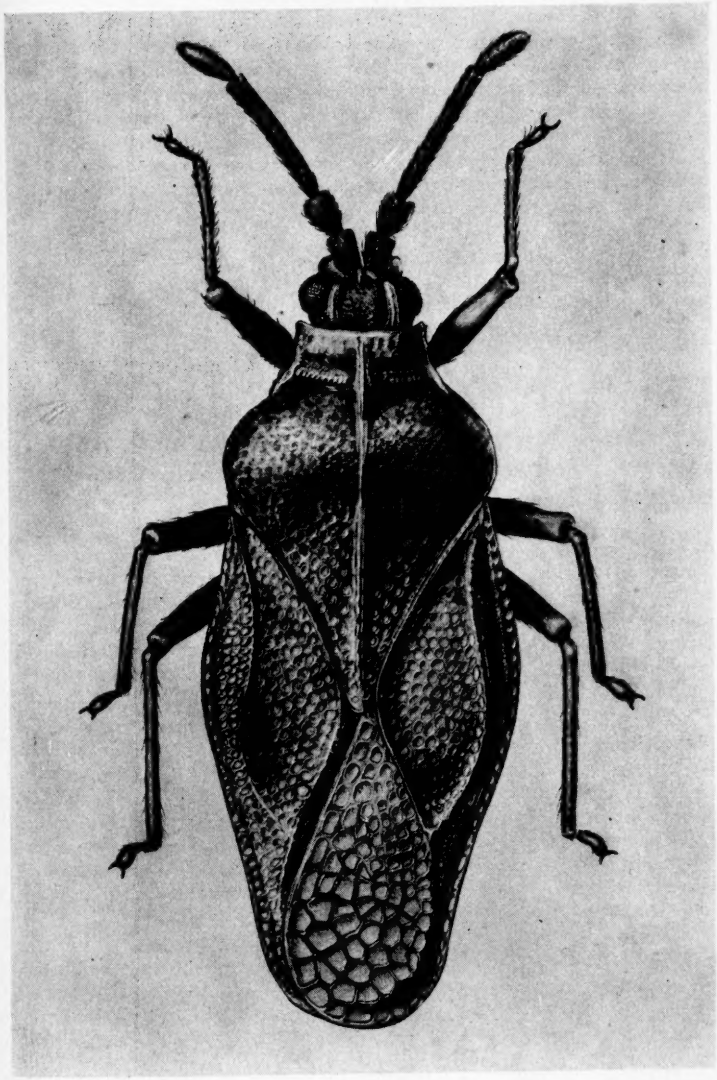

FIG. 1. *Leptoypha barberi*, n. sp., ♂.

composed of one row of small areolae; discoidal area much wider than costal, nearly upright; triseriate in wider part; discoidal area large, extending beyond middle of elytra, widest beyond middle, there five or six areolae deep; sutural area on same horizontal level as discoidal area. Metathoracic wings longer than abdomen, clouded with dark brown-fuscous.

Holotype (male), *allotype* (female), and 40 *paratypes,* Huachuca Mts., Arizona, July-August, 1905. Other paratypes consist of 14 specimens, Patagonia, Ariz., June 12, 1934, A. A. Nichol, and 6 specimens, Tucson, Ariz., August, 1934, C. J. Drake.

This species can be separated from *L. minor* McAtee by its narrower and more oblong form, paler color, longer third antennal segment (40:30), and the sparse, inconspicuous, flake-like, golden pubescence.

ECOLOGICAL REMARKS ON SOME TENEBRIONIDS CONNECTED WITH STORED ANIMAL FOOD IN THE MOJAVE DESERT, CALIFORNIA

CHARLES S. PAPP[1] AND HAROLD D. PIERCE[2]

For purposes of clarification to those not familiar with the Mojave Desert region, we shall define this area as extending from Victorville on Hwy. 395, westward to Palmdale and Lancaster, then north to the desert town of Mojave. A vast grain-growing region extending approximately 30 miles west of Lancaster, along Hwy. 138 and its surrounding area, should also be included. Elevations of 2000 to 4000 feet denote the common term of "High or Upper Desert."

The Mojave Desert harbors one of the most unusual populations of Tenebrionids in the western part of the United States. During past collecting trips and surveys in this area, we noticed that many species were found in close association with stored grain products. With further investigation, it was found not to be a mere coincidence. Instead, these beetles were adapting themselves to this ready food source. The most common host materials are stored barley and mixed poultry feeds. We do not intend to state that these species are immediate economic threats, but their presence does warrant further study.

Due to the nocturnal habits of these Tenebrionids, daylight study is difficult. During the day these beetles may be found under sacked material, in burrows, and under debris. The stronger *Eleodes* species mine tunnels under and around the food source. At night vast numbers may be observed in their feeding habits. During one night's visit to field storage tanks, west of Lancaster, several *Eleodes* species were seen very voraciously feeding on shole barley, the most common being *Eleodes dentipes* Esch. The poultry

[1] University of California, Riverside, Calif.
[2] U.S.D.A., Plant Pest Control Division, Riverside, Calif.

feed has made an excellent environment for many of the smaller and weak-jawed species. Many of the poultrymen are concerned that some of these small Tenebrionids may well emerge as general pests. *Metaclisa marginalis* Horn is perhaps the most abundant. This species can be found in major infestation numbers.

Specimens observed and collected could be arranged in four distinctive groups. The most common stored product species of this family were *Tenebrio molitor* L. and *T. obscurum* Fabr. We found one specimen of *T.*

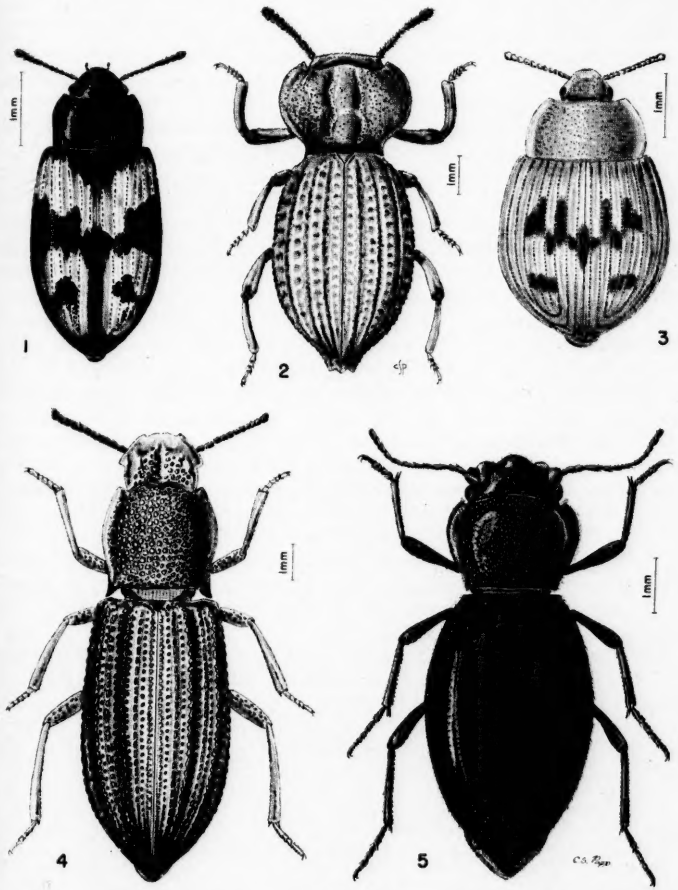

FIG. 1. *Scaphidema pictum* Horn. 2. *Trogloderus costatus tuberculatus* Blaisd. 3. *Phaleria globosa* LeC. 4. *Nyctoporis carinata* LeC. 5. *Triorophus simplex* Csy.

picipes Hbst. *Tribolium confusum* J. Duval was generally found anywhere food was stored. These represent the first group, the well-known stored product insects.

The second group includes specimens found feeding directly on stored food, but not mentioned as stored product insects. They are the following: *Euschides lecontei* Horn, *Eleodes dentipes* Esch., *Coniontis nemoralis* Esch., *C. ellyptica* Csy., *Phaleria globosa* LeC. (Fig. 3), *Metoponium convexicolle* LeC., *Ulus crassus* LeC., *Metaclisa marginalis* Horn, *Blapstinus sulcatus* LeC., *Nyctoporis carinata* LeC. (Fig. 4), and *Trogloderus costatus tuberculatus* Blaisd. (Fig. 2).

The third group includes insects observed and collected in the vicinity of stored food, but not more than two feet from the stored material. These are: *Eulabis obscura* LeC., *Asidopsis opaca* Say, *Eleodes gigantea meridionalis* Blaisd. and *E. armata* LeC.

The fourth group consists of species found under the ground where the food was stored. This group includes species found at a distance not more than three feet from the edge of spoiled food. They are the following: *Eleodes acuticauda laticollis* LeC., *E. granosa* LeC., *E. hispilabris* Say, *E. consobrina* LeC., *E. blanchardi* Blaisd., *E. gracilis distans* Blaisd., *Scaphidema pictum* Horn (Fig. 1), *Blapstinus dilatatus* LeC., *Triorophus simplex* Csy. (Fig. 5), *Argoporis bicolor* LeC., *Centronopus punctatus* Blaisd., *Amphidora nigropilosa* LeC. and *Pelecyphorus acutosus* Horn. Remarkable is the mass occurrence of the above-mentioned *Pelecyphorus* in the Quartz Hill area, where nearly 100 specimens were collected in one place on a chicken farm. Previously only a damaged specimen had been found, on the surface of the ground, in the summer of 1956 near the desert town of Mojave.

The taxonomic part of this work may not be appreciated by many economic entomologists, but we certainly hope it may give some inspiration for students to spend some time on those species of Tenebrionidae which are perhaps not important pests today. Almost every farmer we talked to during our numerous trips asked about the life history and habits of beetles collected. Not as much interest was shown in the well-known species. It gives some indication that, in many instances, the neglected beetles are more "trouble makers" on the farm than is believed in the laboratory.

The authors wish to acknowledge the help of Mr. George T. Okumura and Mr. George M. Buxton, both systematic entomologists with the California State Department of Agriculture, in the identification of the species of the genera *Pelecyphorus* and *Trogloderus*. The receipt of any material collected in similar circumstances would be greatly appreciated by the authors.

RECOGNITION AND DURATION OF LARVAL INSTARS OF THE RICE WEEVIL AND THE GRANARY WEEVIL[1, 2]

EDWIN L. SODERSTROM[3]
Kansas State University, Manhattan

Knowledge of the biology and identification of internal-feeding insects attacking stored grain has become increasingly important with (1) the increased efficiency in techniques to detect internal-feeding insects; (2) the more stringent regulations concerning the presence of insects and residues of pesticidal chemicals in food and (3) lengthy storage of large quantities of grain.

Preliminary investigations in this laboratory have shown that measurements of larval lengths and weights are not reliable because they vary considerably within a given instar. Dyar (1890) found the head capsule width within each instar to be essentially constant and suggested that it might be used to determine larval instars. Measurement of mandibles also has been suggested but that is more difficult.

O'Donnell (1956) made head capsule measurements on a population of Kansas rice weevils which he designated as *S. oryza* (L.) but which was later identified by Floyd and Newsom (1959) as *S. sasakii* (Tak.). Similar measurements were made by Cotton (1920), probably on *S. oryza* in corn under undesignated rearing conditions; and by Kunike (1936), Nakayama (1926), and Richards (1947) on the granary weevil.

Objectives of this investigation were to record head capsule measurements at a definite location on the head for use in determining instars of a population of *S. oryza* from Arkansas and a laboratory culture of the granary weevil, and to determine developmental time of the various instars with weevils reared in wheat under controlled environmental conditions.

MATERIALS AND METHODS

The granary weevils were originally obtained from the United States Department of Agriculture, Stored Products Insect Laboratory, Manhattan, Kansas. At varying intervals, adults have been added from nearby granaries. They are designated as "Kansas granary weevil." The rice weevil culture, hereafter designated the "Arkansas rice weevil," was obtained from Arkansas from Paul Boles.

Culture wheat used was Pawnee hard red winter wheat, grown in 1956 in Allen County, Kansas. Weevils were maintained in stock cultures in rearing rooms at 80 degrees F. and 70% relative humidity. The granary

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[1] *Sitophilus oryza* (L.), and *S. granarius* (L.), respectively.

[2] Contribution No. 759, Department of Entomology, Kansas Agricultural Experiment Station, Manhattan. Supported in part by Grant E-1942, National Institutes of Health, U. S. Public Health Service.

[3] Graduate Research Assistant. Portion of a thesis submitted in partial fulfillment of Degree Master of Science. Direction and encouragement by Prof. D. A. Wilbur is gratefully acknowledged.

weevils were reared November 23, 1957, through March 5, 1958, while the rice weevils were reared March 19 through May 17, 1958.

The experimental cultures were reared in one quart, wide-mouth jars. Exclusion of other insects was accomplished by covering each jar with 40-mesh wire screen and a filter paper. In each jar, 150 unsexed weevils were placed on 150 grams of 13.5% moisture wheat for an oviposition period of three days under approximately 70% relative humidity and 80 degrees F. A model 500 G Steinlite moisture tester was used to determine grain moisture.

At the termination of the oviposition period, the adults were removed by screening and all grain was combined and thoroughly mixed, after which 150 grams were placed in each of the original containers. The cultures were then returned to the rearing room.

Daily one experimental culture jar was removed from the rearing room, thoroughly mixed, and 100 whole kernels selected at random. Selected kernels were placed in acid fuchsin stain solution, which resulted in the egg plugs staining a cherry red (Frankenfield, 1948). Infested kernels were located under a dissecting microscope and 10 larvae removed. The number of granary weevil larvae observed was 154, 127, 128, and 261, respectively, for instars one through four. The number of Arkansas rice weevils observed was 162, 129, 137, and 258 for instars one through four, respectively.

The head capsule of each larva was removed and mounted in balsam on a glass microscope slide with the occipital foramen down and the coronal suture disposed vertically in the field of vision when viewed through a microscope.

Measurements were made with a calibrated ocular in a broadfield, dissecting microscope. At 90×, each calibration mark equaled 0.0165 mm. and the head capsules were estimated to quarters of a calibration or 0.0041 mm.

The research was conducted in 1957-1958.

RESULTS AND DISCUSSION

Head Capsule Width. The Arkansas rice weevil head capsule measurements, in comparison with Cotton's data, averaged 0.02 mm. greater in the fourth instar (Table 1). Kunike's granary weevil measurements varied most from this writer's in the third instar, viz., 0.05 mm. less. Richards' (1947) varied most in the first instar (0.01 mm. less). Nakayama (1926) recorded larger measurements in the second and third instars and much smaller measurements in the fourth instar. His rearing medium presumably was rice.

Head capsule width variation in the Arkansas rice weevil population within each instar was least in the second instar, but increasingly greater in the first, third, and fourth instars, respectively. This same respective increase was also found in O'Donnell's Kansas *S. sasakii* measurements.

Mean head capsule widths were compared using Dyar's Law, as calculated by Imms (1924). The largest deviation of the observed means from the calculated means was 0.02 mm., in the fourth instar of the Kansas

TABLE 1. Width of Head Capsules of Larval Populations of Three Species of *Sitophilus* (in millimeters).

	1st Instar			2nd Instar			3rd Instar			4th Instar		
	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.
Present study:												
S. oryza[a] ..... Wheat	.18	.22	.27	.28	.32	.36	.38	.47	.57	.58	.66	.80
S. granarius[b] ..... Wheat	.17	.25	.29	.30	.35	.43	.45	.51	.61	.62	.68	.82
Other workers' studies:												
S. sasakii[c] ..... Wheat	.16	.20	.22	.25	.28	.29	.34	.39	.43	.49	.54	.64
S. oryza[d] ..... Corn		.22			.32			.48			.64	
S. granarius[e] ..... Wheat		.23			.32			.46			.64	
S. granarius[f] ..... Wheat	.20	.24	.28	.30	.35	.39	.42	.51	.58	.60	.68	.76
S. granarius[g]		.25			.37			.52			.61	

[a] Arkansas population. [b] Kansas population. [c] O'Donnell (1956). [d] Cotton (1920). [e] Kunike (1936). [f] Richards (1947). [g] Nakayama (1926).

TABLE 2. Number of Eggs, Instars, and Pupae of Kansas Laboratory Populations of the Granary Weevil, *Sitophilus granarius* (L.), and of the Arkansas Rice Weevil, *Sitophilus oryzae* (L.), in Days, from the First Day of Exposure of the Wheat to the Adult Weevils for Oviposition.

Days	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Granary Weevil																												
Egg	18	12	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1st Instar	12	18	28	27	28	18	10	10	3	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2nd Instar	0	0	0	1	1	12	20	19	24	15	11	8	8	2	2	2	0	1	1	0	0	0	0	0	0	0	0	0
3rd Instar	0	0	0	0	0	0	0	1	3	9	16	20	18	16	10	12	5	4	2	0	3	1	1	3	1	1	1	0
4th Instar	0	0	0	0	0	0	0	0	0	0	0	1	3	12	17	16	25	25	27	29	23	20	19	13	10	9	8	2
Pupa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	8	9	12	14	15	14	15
Arkansas Rice Weevil																												
Egg	27	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	....	....	....	....	....	....	....	....
1st Instar	13	36	39	34	24	12	6	1	2	2	1	0	0	0	0	0	0	0	0	0	....	....	....	....	....	....	....	....
2nd Instar	0	0	0	4	14	27	34	29	12	7	3	0	0	0	0	0	0	0	0	0	....	....	....	....	....	....	....	....
3rd Instar	0	0	0	0	0	0	0	10	25	30	28	17	12	3	2	5	4	0	0	1	....	....	....	....	....	....	....	....
4th Instar	0	0	0	0	0	0	0	0	1	1	8	23	28	37	36	35	33	32	18	6	....	....	....	....	....	....	....	....
Pupa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	7	21	33	....	....	....	....	....	....	....	....

granary weevils. Analysis of variance showed that 97% of the total variation was the result of instar effect.

Development. Table 2, wherein the number of specimens is plotted against successive days of development, shows that the number of larvae in each instar of the Kansas granary weevils and the Arkansas rice weevils both rose abruptly to a peak, dropped sharply, and then tapered off gradually in the latter days. This was particularly true during the first three instars.

Instars one through four of the Kansas granary weevil extended over 11, 15, 19 and 16+ days, respectively, and 10, 7, 9, and 11+ days for the Arkansas rice weevil, respectively.

Overlapping of instars was greatest during the fourth instar in both species, followed, in descending order, by the third, second, and first instars. This overlapping, as well as gradual tapering off following the peak, was the result of one or more of the following factors: natural variability in speed of development of the weevils, variability of wheat kernels and/or difference in time of oviposition over the three-day oviposition period.

The Arkansas rice weevil developmental period from egg to pupa was shorter than that of the granary weevil.

DISCUSSION

Recognition of instars of a given weevil population makes it possible to determine the effects of fumigants on the various instars. Position of the various instars within the kernel may also be determined as well as other individual instar behavior. However, determining species by measurement is not feasible, because of the overlapping of head widths of instars between species.

Knowledge of the length of development of each instar makes it easier to obtain for experimental purposes a certain given instar on a given day.

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TWO NEW SPECIES OF *FULICOFFULA* (Mallophaga) FROM THE SORA

K. C. EMERSON
Stillwater, Oklahoma

The Ischnoceran genus *Fulicoffula* Clay and Meinertzhagen, 1938, is found in North America (north of Mexico) on hosts of the avian family Rallidae. *F. longipila* (Kellogg, 1896) found on the Coot, *Fulica americana* Gmelin, is fairly common. *F. comstocki* (Kellogg and Chapman, 1902) found on the Virginia Rail, *Rallus limicola* Vieillot; and *F. gallinula* Carriker, 1953, found on the Gallinule, *Gallinula chloropus* (Linnaeus), are apparently rare. The remaining known species are from hosts which do not occur in North America. Two new species found on the Sora are herewith described and illustrated.

Fulicoffula americana n. sp.

MALE. General shape and chaetotaxy as shown in Figure 2. Genitalia, less genital sac, as shown in Figure 3.

FEMALE. General shape and chaetotaxy as shown in Figure 1. Posterior margin of genital plate as shown in Figure 4.

DISCUSSION. This species is apparently closest to *F. gallinula*. The shape and chaetotaxy of the female genital plate as shown in Figure 4 is distinctive. In *F. gallinula,* this structure possesses approximately twelve short and twenty medium-length setae on the posterior margin. In the male, tergites of abdominal segments V-VII are shorter in *F. gallinula* than in *F. americana.* Distinctive features of the male genitalia are thin tapering paramera, long narrow endomera, and a large mesosomal plate. In addition, *F. americana* is larger than *F. gallinula.*

TYPE HOST: *Porzana carolina* (Linnaeus), Sora.

TYPE MATERIAL: Holotype male and one paratype collected at Orient, New York, on October 2, 1931, by Roy Latham in the Entomological Collection of Cornell University. Allotype female and six paratypes collected at Stillwater, Oklahoma, on June 5, 1948, by the author. The allotype will be deposited in the U. S. National Museum. One paratype collected at Arlington, Virginia, by William Palmer on September 24, 1898, in the U. S. National Museum. One paratype collected in Douglas County, Kansas, in May, 1909, in the Snow Entomological Museum, The University of Kansas.

Fulicoffula distincta n. sp.

MALE. General shape and chaetotaxy as shown in Figure 7. Total length 2.25 mm. Male genitalia as shown in Figure 6.

FEMALE. Head, except for filiform antennae, as in the male. Abdomen, except for genital region, as in *F. americana.* Total length 2.56 mm. Shape and chaetotaxy of genital plate as shown in Figure 5.

DISCUSSION. In many respects, this species is atypical. The following characters are not found in other species of the genus: (1) narrow head in both sexes, (2) short stout spines on the posterior margin of the female genital plate, (3) short abdominal segments IV-V in the male (in typical

species, segments VI-VIII are short), (4) long, slender, simple paramera, and (5) the absence of a prominent mesosomal plate in the male genitalia.

TYPE HOST: *Porzana carolina* (Linnaeus), Sora.

TYPE MATERIAL: Holotype male and one paratype collected at Stillwater, Oklahoma, on June 5, 1948, by the author. The holotype will be deposited in the U. S. National Museum. Allotype female collected at Moscow, Idaho on May 2, 1952, by T. D. Burleigh; one paratype collected

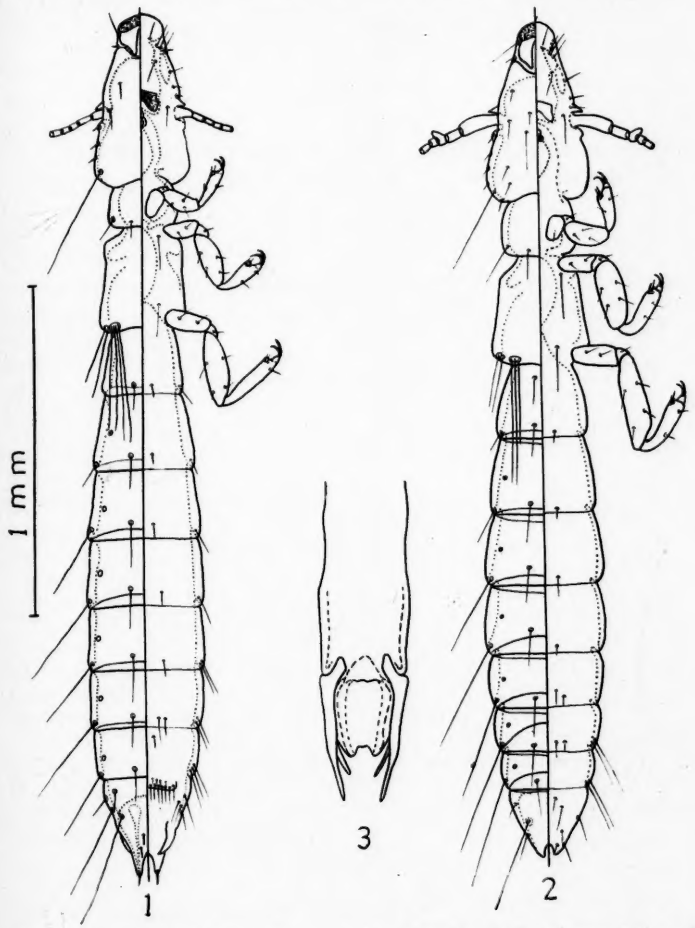

PLATE I. Figures 1-3. *Fulicoffula americana* n. sp. Fig. 1. Dorsal-ventral view of female. Fig. 2. Dorsal-ventral view of male. Fig. 3. Male genitalia.

near Cutler, Florida, on January 12, 1930, by E. J. Brown; and one paratype collected at Bay St. Louis, Mississippi, on March 7, 1902, by A. Allison in the U. S. National Museum. Five paratypes collected at Orient, New York, on October 2, 1931, by Roy Latham in the Entomological Collection of Cornell University.

The Sora is the only host from which two species of *Rallicola* have been collected. It is also the only host from which two species of *Fulicoffula* have been collected.

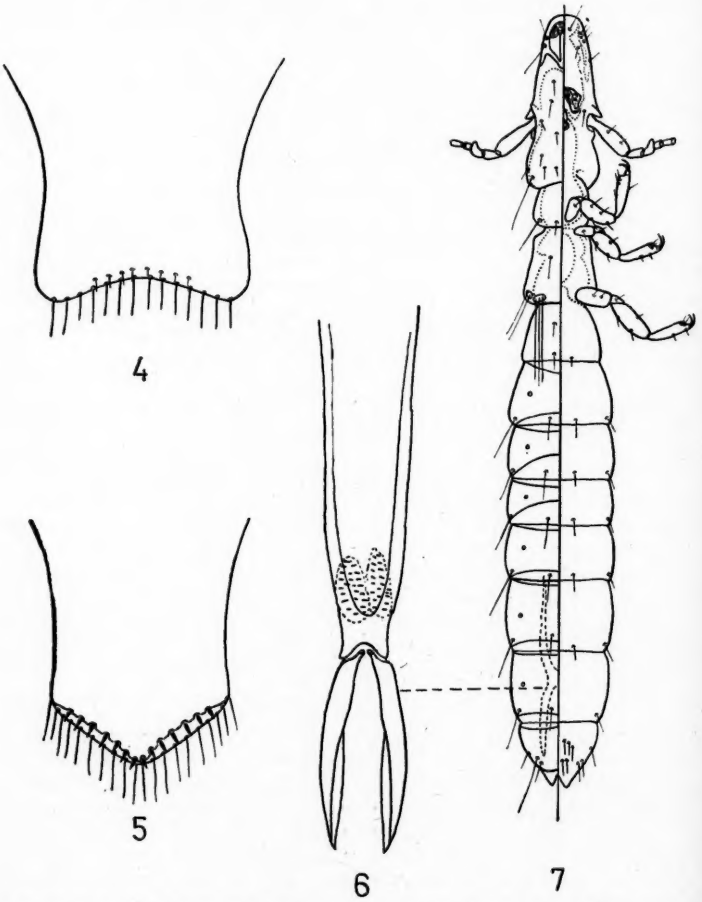

PLATE II. Figure 4. *Fulicoffula americana* n. sp. Fig. 4. Female genital plate. Figures 5-7. *Fulicoffula distincta* n. sp. Fig. 5. Female genital plate. Fig. 6. Male genitalia. Fig. 7. Dorsal-ventral view of male.

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THE SUSCEPTIBILITY OF SOME AMERICAN WHEATS TO THE WHEAT BLOSSOM MIDGES

H. F. BARNES AND MARGARET K. ARNOLD
Rothamsted Experimental Station, Harpenden, Herts., England

One of the Wheat Blossom Midges, *Sitodiplosis mosellana* (Géhin), has occasionally been recorded as injurious in Canada and the United States. The other, *Contarinia tritici* (Kirby), has never been confirmed as occurring in North America, although before 1912 many authors mistakenly reported its presence. Comprehensive accounts of both species are given by Barnes (1956).

The purpose of this investigation was to determine whether American wheats bred for their resistance to Hessian Fly show any resistance to either of these two midges.

The experiment consisted simply in growing certain wheat varieties in a locality where both the Wheat Blossom Midges occur and in assessing the subsequent infestation of each variety by each of the midges.

The wheat varieties used were the same as those tested for their resistance to Hessian Fly of mixed foreign parentage (Barnes, 1960): namely Peko, an English spring wheat; Marquardts brauner Dickkopf, a German winter wheat that has been recorded by German workers as having exceptionally low infestations, especially by *C. tritici;* and seven winter and two spring American varieties. These were in order of known resistance to Hessian Fly in America; Durum (P.I.94587), a spring wheat, and Pawnee x P.I.94587 (12855); Mediterranean-Hope-Pawnee x Oro-Ill.I-Comanche (12804), Dual (13083), Gelou-Oro x Cheyene-Tenmarq (KS 46799) and Ill.no.IW 38, a spring wheat; Ponca (12128) and Marquillo-Oro x Triunfo (12858); and Tenmarq (C 16936). These varieties show a wide range in awn-length as illustrated in Plate I.

METHODS

These were similar to those previously used to assess the infestation of three spring wheats (Atle, Svenno and Fylgia) by the Wheat Blossom Midges (Barnes, Miller & Arnold, 1959).

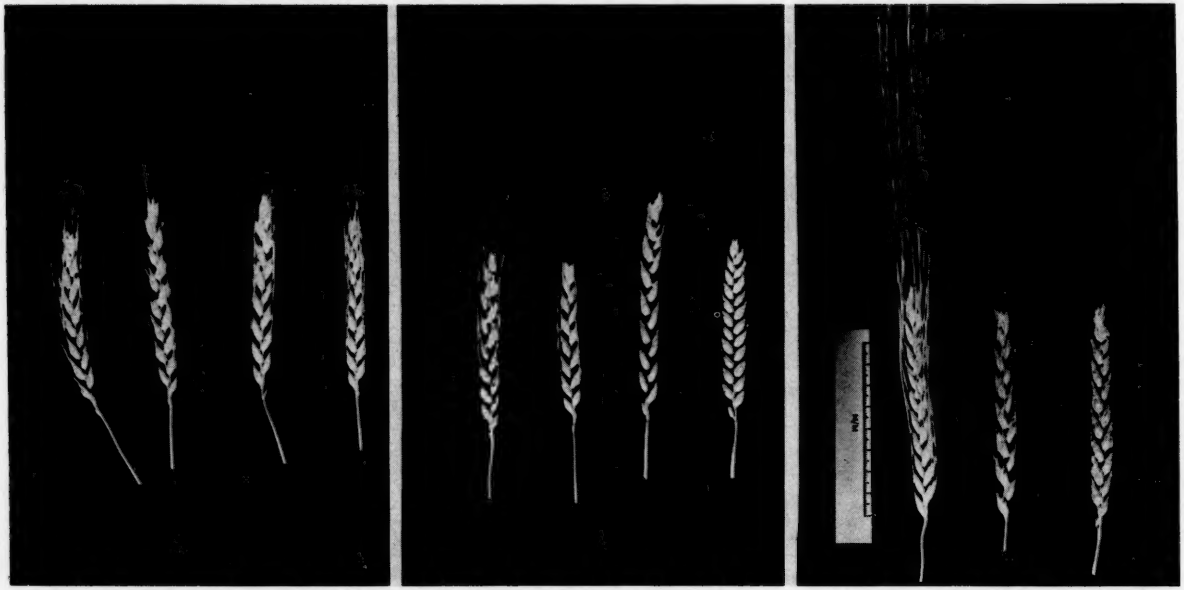

PLATE 1. Ears of the wheats tested to demonstrate the awn-length. 1. Tenmarq, 2. Ponca, 3. Pawnee x P.I. 94587, 4. Mediterranean-Hope-Pawnee x Oro-Ill.I-Commanche, 5. Marquillo-Oro x Triunfo, 6. Gelou-Ora x Cheyenne-Tenmarq. 7. Dual, 8. Marquardts brauner Dickkopf, 9. Durum, 10. Ill.no.IW 38 and 11. Peko. (Rothamsted Experimental Station copyright.)

The wheats were sown in seed boxes or flats to avoid damage by slugs, mice and birds and kept in an open unheated glasshouse. One sowing of the winter wheats was made on 27 November 1958 and of the spring wheats (Durum, Ill.no.IW 38 and Peko) on 5 March 1959. A second sowing of the winter wheats was made on 5 February and of the spring wheats on 12 March.

The wheats were later transplanted into double rows, about 15 ft. long, in the garden of Rothamsted Lodge. These rows were covered with wire netting to avoid destruction by sparrows that were known from previous experience frequently to uproot young seedlings and eat the remains of the grain. The winter wheats of the first sowing were planted out on 25-26 February and the spring wheats on 25 March. The winter wheats of the second sowing were planted out on 23-24 March and the spring wheats on 9 and 10 April. It was obvious later that the earlier transplanted wheats scarcely tillered, whereas the later transplants tillered freely and provided bottom-cover for the flying midges.

At the time of ear-burst, the visible ears were counted each morning and the *C. tritici* and *S. mosellana* ovipositing on the ears were counted each evening, between 16.30 and 19.00 hours G.M.T. It was realised that this time of day was rather early for oviposition by *C. tritici,* even though the wheat rows were by then in partial shade, and much too early for oviposition by *S. mosellana.* These counts started on 4 June when the first *C. tritici* females were seen, and continued until 2 July, by when the flight of midges was apparently over because no midge had been seen on the ears since 30 June. The daily numbers of both midges that emerged in the insectary at Rothamsted Lodge were available for comparison. It should be remembered that the midges are short-lived and lay most of their eggs the same day that they emerge.

On 2 July a sample of 25 ears from each variety in the earlier transplant was collected and examined later for the numbers of grains infested and numbers of larvae per infested grain. On 3 July the remaining ears of this transplant were cut and 50 of each variety were later examined. This examination was in more detail. The spikelets and grains per ear were counted, as were the infested grains and larvae per infested grain.

The infestation in the later transplant was assessed in the same two ways. It was decided to cut all the ears on 9 July, but unfortunately after six varieties had been harvested there was a thunderstorm in which 0.49 inch of rain fell in about one hour. The remaining varieties (Dual, Durum, Ill.no.IW 38, Marquardts and Peko) were therefore harvested a day later. Full-grown larvae of these midges are liable to leave the ears suddenly when rain follows dry weather, so the figures for infestation of these five varieties were expected to be comparatively less than those of the varieties collected before the rain came. It was possible to compare the infestation on Gelou-Oro x Cheyenne-Tenmarq on 9 July, before the rain, and on 10 July, after the rain, because this variety was partially harvested before the storm started.

OVIPOSITION

Figure 1 shows the numbers of *C. tritici* females seen on the rows of wheat varieties in the first and second transplants and the numbers that emerged daily in the insectary. The first specimen was seen on the first transplants on 4 June and on the second transplants on 7 June; the peaks were respectively on 18 and 19 June; the last individuals were seen on 29 and 30 June. In the insectary the females started emerging on 10 June, reached a peak (174) on 19 June, and the last one emerged on 2 July.

Few *S. mosellana,* as was expected, were seen ovipositing, but the first was seen on 7 June. Most (47) were seen on 20 June and the last on 29 June. In the insectary the first female emerged on 7 June, the peak (103) occurred on 21 June and the last emerged on 4 July.

Table 1 shows the numbers of *C. tritici* females seen on the various wheat varieties throughout the period of observation. Many more midges were seen on second than on the first transplants.

TABLE 1. Numbers of *C. tritici* Seen Ovipositing 4-30 June.

Variety	1st transplant	2nd transplant
Winter wheats		
Tenmarq (C.16936)	143	464
Ponca (12128)	36	260
Pawnee x P.I.94587 (12855)	83	344
Mediterranean-Hope-Pawnee x Oro-Ill.I-Comanche (12804)	47	261
Marquillo-Oro x Triunfo (12858)	62	377
Gelou-Oro x Cheyenne-Tenmarq (KS 46799)	44	436
Dual (13083)	122	1252
Marquardts brauner Dickkopf	89	92
Spring wheats		
Durum (P.I.94587)	142	284
Ill.no.IW 38	229	408
Peko	126	416

EAR-BURST OF THE WHEAT VARIETIES

Figure 2 shows the numbers of ears visible each day from 4 June to 2 July on six varieties (Marquillo-Oro x Triunfo, Dual, Durum, Ill.no.IW 38, Marquardts and Peko) in the first transplant rows. Figure 3 shows the ear-burst of the same six varieties in the second transplants.

The progress of ear-burst of the remaining varieties followed closely that of Marquillo-Oro x Trinunfo. Full data are available. The number of visible ears increased uniformly and at much the same time in most of the varieties, but ear-burst of two spring varieties, Durum and Peko, and one winter wheat, Marquardts, was much later in both transplants. That of the remaining spring wheat, Ill.no.IW 38, was as early as the majority of the winter wheats. One winter variety, Dual, started earing later than the others, but its rate increased more rapidly. The percentage ear emergence of each variety on the day of the peak emergence of *C. tritici* is given in Table 2. The first transplanted wheats on the whole had a greater percentage of their ears visible when the peak of *C. tritici* emergence was

reached. But the total number of ears emerged on that date was greater in the rows of six of the eleven varieties of the second transplant than in those of the first transplant.

TABLE 2. Percentage Ear Emergence at Peak of *C. tritici* Emergence.

Variety	1st transplant	2nd transplant
Winter wheats		
Tenmarq (C.16936)	75	54
Ponca (12128)	64	68
Pawnee x P.I. 94587 (12855)	71	49
Mediterranean-Hope-Pawnee x Oro-Ill.I-Comanche (12804)	79	65
Marquillo-Oro x Triunfo (12858)	78	68
Gelou-Oro x Cheyenne-Tenmarq (KS 46799)	74	68
Dual (13083)	60	35
Marquardts brauner Dickkopf	6	0
Spring wheats		
Durum (P.I.94587)	29	25
Ill.no.IW 38	56	57
Peko	0.8	1.4

INFESTATION

Table 3 gives the infestation of each of the transplants. The average number of larvae per infested grain indicates that the samples were taken before appreciable numbers of larvae had left the ears. Nevertheless

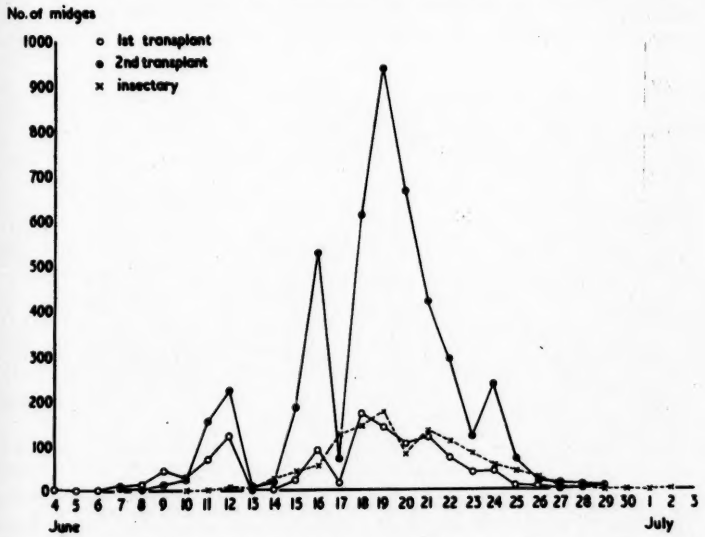

FIG. 1. Numbers of female *C. tritici* seen daily on the ears of the first and second transplanted wheats, together with those emerging in the insectary.

the fact that the average number of *C. tritici* larvae on nine of the eleven wheat varieties was lower in the second transplant samples than in the

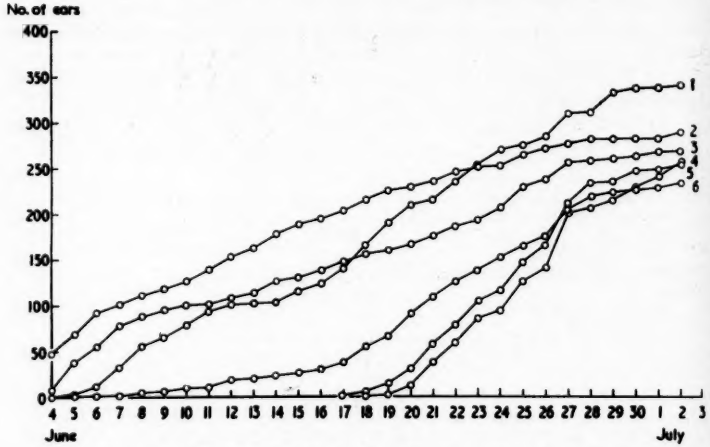

FIG. 2. Ear-burst of 1. Ill.no.IW 38, 2. Marquillo-Oro x Triunfo, 3. Dual, 4. Peko, 5. Marquardts brauner Dickkopf and 6. Durum, in the first transplanted rows.

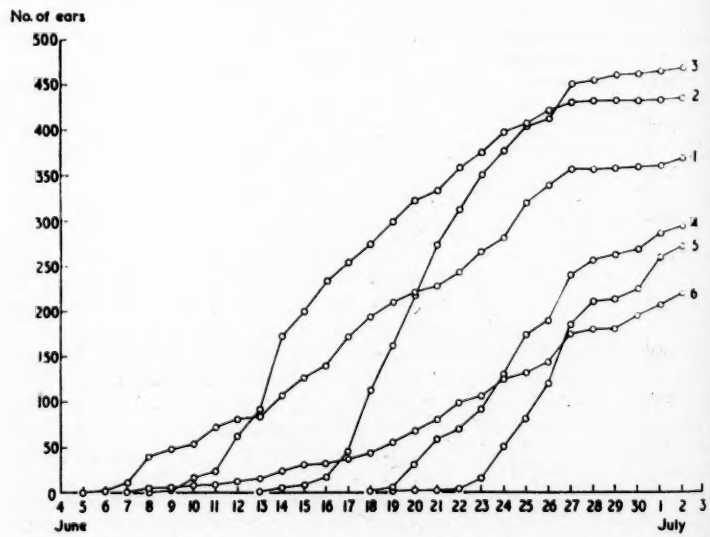

FIG. 3. Ear-burst of 1. Ill.no.IW 38, 2. Marquillo-Oro x Triunfo, 3. Dual, 4. Peko, 5. Marquardts brauner Dickkopf and 6. Durum, in the second transplanted rows.

first indicates that the larvae of this species had started to leave between 3 and 9 July.

Seven of the winter wheats (Tenmarq, Ponca, Pawnee x P.I.94587, Mediterranean-Hope-Pawnee x Oro-Ill.I-Comanche, Marquillo-Oro x Triunfo, Gelou-Oro x Cheyenne-Tenmarq and Dual) and one spring wheat (Ill.no.IW 38) had percentage grain infestations by *C. tritici* ranging from 4.0 to 10.3 in the first transplant and from 5.0 to 10.6 in the second. The intensity of attack, particularly on the second transplants, is comparable to that on Plot B on the Broadbalk wheat (Square Heads Master) on 5, 7 and 9 July. Samples taken on Broadbalk field on 13 July were less infested because by then many of the larvae had left the wheat. On the remaining winter wheat, Marquardts, and the two other spring wheats, Durum and Peko, the infestations were much lower. This is because ear-burst occurred on them when the year's flight of midges was nearly ended. Seven of the eleven varieties in the second transplants had a larger percentage of their grain attacked than did the first. *C. tritici* larvae were more numerous on five of the varieties in the second transplants than in the first.

With one exception the infestations by *S. mosellana* fell into similar groups of higher and lower attacks. Six of the seven wheats that had the higher infestations by *C. tritici* had infestations by *S. mosellana* ranging from 4.6 to 9.5 percent grain attacks in the first transplants and from 8.2 to 12.7 in the second. The seventh, Marquillo-Oro x Triunfo, had only 1.2 and 3.4 percent attacks respectively in the two transplants. The three varieties in which earing was late in comparison with the midges' flight period had low infestations. All eleven varieties showed increased percentage grain attack and number of larvae in the second transplant over the first.

DISCUSSION AND CONCLUSIONS

The close parallelism between the emergence dates of the Wheat Blossom Midges in the insectary at Rothamsted Lodge and in the open was once again shown.

Bottom-cover has long been known to afford protection to Wheat Blossom Midges. This was confirmed by the fact that a total of 4,594 *C. tritici* were seen on the ears of the second transplants that had tillered freely whereas only 1,123 were seen on those of the first transplants that had not.

The uniformity of date of ear-burst among the varieties of winter wheat sown on 27 November and transplanted in the open on 25-26 February, as well as between those sown on 5 February and transplanted outside on 23-24 March, is striking. The exception was the German variety Marquardts brauner Dickkopf. The late start but more rapid development of ear-burst of Dual of the second transplant should also be mentioned. This uniformity was not noticeable in spring wheats, of which one set was sown on 5 March and the other on 12 March and transplanted outside on 25 March and 9 and 10 April respectively.

C. tritici was seen ovipositing freely on all the varieties. The length of awn did not appear to affect egg-laying and many midges laid on Durum, which has the longest awns. It is true that most were seen on the ears of

TABLE 3. Infestation of the First Transplanted Wheats on 3 July 1959 (Above). Infestation of the Second Transplanted Wheats on 9 and 10* July 1959 (Below).

Variety	Total larvae in 50 ears		Percentage grain attack		Average number of larvae per infested grain	
	T	M	T	M	T	M
Winter wheats						
Tenmarq (C. 16936)	2055	211	9.8	6.5	10.8	1.7
Ponca (12128)	808	124	5.2	6.3	12.1	1.5
Pawnee x P.I.94587 (12855)	1853	214	10.3	9.5	10.6	1.3
Mediterranean-Hope-Pawnee x Oro-Ill.I-Comanche (12804)	1297	208	8.1	9.0	11.0	1.6
Marquillo-Oro x Triunfo (12858)	986	30	5.4	1.2	11.0	1.5
Gelou-Oro x Cheyenne-Tenmarq (KS 46799)	555	97	4.3	4.7	9.6	1.5
Dual (13083)	600	138	4.0	4.9	7.7	1.5
Marquardts brauner Dickkopf	93	15	0.3	0.5	10.3	1.2
Spring wheats						
Durum (P.I.94587)	563	115	2.4	3.4	9.5	1.4
Ill.no.IW 38	1495	109	8.3	4.6	10.2	1.3
Peko	109	2	0.8	0.1	6.4	1.0
Winter wheats						
Tenmarq (C.16936)	1171	265	8.2	10.9	9.1	1.6
Ponca (12128)	605	145	5.0	9.4	10.6	1.4
Pawnee x P.I.94587 (12855)	1642	220	10.5	10.0	10.4	1.5
Mediterranean-Hope-Pawnee x Oro-Ill.I-Comanche (12804)	1843	259	10.6	12.7	11.7	1.4
Marquillo-Oro x Triunfo (12858)	1340	74	7.0	3.4	12.1	1.4
Gelou-Oro x Cheyenne-Tenmarq (KS 46799)	1396	213	8.4	8.6	10.5	1.6
Dual (13083)*	1214	206	9.5	8.2	7.0	1.4
Marquardts brauner Dickkopf*	43	85	0.2	2.6	7.2	1.3
Spring wheats						
Durum (P.I.94587)*	173	129	0.9	3.8	8.2	1.4
Ill.no.IW 38*	1376	296	9.8	12.3	8.2	1.4
Peko*	326	61	1.6	2.6	11.2	1.3

Note: T indicates *C. tritici*, M indicates *S. mosellana*.

the secondly transplanted Dual, which has very short awns, but this may have happened because of the large amount of bottom-cover for the midges in the immediate proximity.

There was no apparent relation between the numbers of *C. tritici* seen ovipositing on the ears and the subsequent larval infestation, but no relation could be expected because the observations covered only a small portion of the daily time when oviposition could have happened. Such observations enable the flight period of the year to be studied in relation to ear-burst. Observations to get comparable results with *S. mosellana* would have to be made considerably later each evening.

Ear-burst of the winter wheat Marquardts and the spring wheats Durum and Peko did not coincide with the flight period of the midges, so no information was gained about the degree of susceptibility of these three varieties. Peko has previously been shown to be susceptible (Barnes, Miller & Arnold, 1959).

The fact that the remaining eight varieties tested were infested similarly to Square Heads Master on Broadbalk field indicates that the site chosen for the experiment is a good one and also that these varieties, with one exception, exhibit no sign of being resistant to either of the Wheat Blossom Midges.

None of the eight varieties, Tenmarq, Ponca, Pawnee x Durum, Mediterranean-Hope-Pawnee x Oro-Ill.I-Comanche, Marquillo-Oro x Triunfo, Gelou-Oro x Cheyenne-Tenmarq, Dual and Ill.no.IW 38, exhibited any difference in susceptibility to *C. tritici*.

The same is true, with one exception, of susceptibility to attack by *S. mosellana*, the species that already occurs in Canada and the United States. The exception is Marquillo-Oro x Triunfo, which was less infested (1.2 & 3.4%) than the others. This cannot be accounted for by too few ears on which the midges could oviposit. A few *S. mosellana* were seen ovipositing on this variety, but unfortunately the observations of midges' egg-laying were made too early in the evening to get much information. The only conclusion that can be drawn is that Marquillo-Oro x Triunfo appears to be the only one of the eight varieties successfuly tested that is worthwhile including in any further trial or selection of varieties possibly resistant to *S. mosellana*.

SUMMARY

Seven American varieties of wheat resistant to Hessian Fly and one susceptible to it are susceptible to *Contarinia tritici* (Kirby) which is not yet known to occur in North America. All these are also susceptible to the other Wheat Blossom Midge, *Sitodiplosis mosellana* (Géhin), which does occur in North America. But Marquillo-Oro x Triunfo (12858) seems to be less susceptible.

The information gained about three other varieties, Marquardts, Durum and Peko, must be discounted because their ear-burst did not coincide with the midges' flight period.

Note: T indicates *C. tritici*, M indicates *S. mosellana*.

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A DOUBLE MOUNT FOR MINUTE ARTHROPODS[1]

FLOYD D. MINER
University of Arkansas

A mount for unusually small Arthropods, which has been in use at the University of Arkansas for several years, appears to have certain advantages over others known to be in use. It is inexpensive, probably a little faster than other methods, and enables the technician to use such a small and accurate point of attachment to the specimen that no important structures are obliterated. In this respect it is at least as good as minuten nadeln, and incomparably better than card points.

The secondary support for the specimen is a slender plastic thread. This is made by holding two insect pins close together and applying a drop of plastic cement commonly to both, at a point ⅜ inch from the heads of the pins. The pins are then pulled about ¾ inch apart, which results in a thread being formed between them. They are held in this position for several minutes, after which the thread is clipped midway between the pins. The result is a thread projecting at right angles from each pin.

Mechanical aids are used for placing, separating and holding the pins steady while the thread is drying. These will not be described, since there are a number of ways of doing it which can easily be devised.

To mount the insect, it is placed in position under a binocular microscope with the right side up. The tip of the thread is brought close to it, ready for instant application. With the other hand, the specimen is flooded momentarily with a drop of some solvent of the cement, using an eyedropper. As the solvent evaporates, the specimen is watched closely. Just as the last bit of liquid is about to leave the body part where attachment is to be made, the thread is brought in contact with it. Everything is then held motionless for a few seconds until all the solvent has evaporated, after which the mount is lifted with the specimen attached.

The basic advantage of the method, other than the fineness of the thread, is the fact that it manufactures its own adhesive, in small amount and at the precise spot where it is needed, and at the moment of attachment so that there is no premature drying of adhesive.

Various cements and solvents can be used, but Duco household cement and acetone for the solvent have been most commonly employed.

[1] Published with the approval of the Director of the Arkansas Agricultural Experiment Station.

Practice and aptitude are necessary for best results, as with any mounting technique. If application of the thread is delayed too long, it will not stick to the specimen. If applied too soon, a large amount of the thread is dissolved and spread over the specimen, thus ruining it. It is best to place the insect on cardboard or paper with blotting properties during the flooding and mounting, to speed the disappearance of the solvent. Regular blotting paper is too fast in this respect, however. Most technicians cannot move rapidly enough to make contact before all the solvent is gone.

Large specimens can be mounted by this method, but there is then no great advantage over cardpoints. The diameter and strength of the thread can be manipulated, however, to accomodate the larger specimens. If the specimen is not too heavy to start with, no drooping or other malfunction seems to appear with time.

Several long-distance parcel post shipments of specimens thus mounted have been made. In one instance there was a loss of about 25% in loose mounts and empty pins. In two other cases virtually no loss occurred. The difference could be due either to slight differences in method, or to the fortunes of handling in the mails.

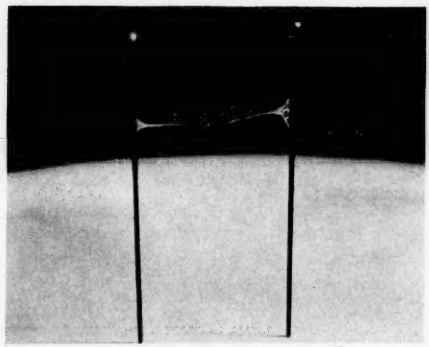

Figure 1 illustrates two specimens mounted as described. One is a small parasite of spotted alfalfa aphid, *Aphelinus semiflavus,* mounted by the thorax. The other is a mite, *Galumna* sp., mounted by the femur of the posterior leg. The pins are size no. 3.

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